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FISCAL YEAR 1982 DEPARTMENT OF ENERGY AUTHORIZATION FOR NATIONAL SECURITY PROGRAMS

HEARINGS

BEFORE THE

SUBCOMMITTEE ON STRATEGIC AND THEATER NUCLEAR FORCES

OF THE

COMMITTEE ON ARMED SERVICES UNITED STATES SENATE

NINETY-SEVENTH CONGRESS

FIRST SESSION

ON

S. 846

A BILL TO AUTHORIZE APPROPRIATIONS FOR THE DEPARTMENT OF ENERGY FOR NATIONAL SECURITY PROGRAMS FOR FISCAL YEAR 1982 AND FISCAL YEAR 1983, AND FOR OTHER PURPOSES

MARCH 13 AND MAY 5, 1981

Printed for the use of the Committee on Armed Services

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CONTENTS

CHRONOLOGICAL LIST OF WITNESSES

MARCH 13, 1981

Page

Edwards, James B., Secretary of Energy 6
Wade, James P., Assistant to Secretary of Defense (Atomic Energy) 37

MAY 5, 1981

Rickover, Adm. Hyman G., USN, Deputy Assistant Secretary for Naval Reactors, U.S. Department of Energy 64
Sparks, Morgan, Ph. D., President, Sandia National Laboratories 263
Batzel, Roger E., Ph. D., Director, Lawrence Livermore National Laboratory 271
Robinson, C. Paul, Ph. D., Associate Director for National Security Programs, Los Alamos National Laboratory, Los Alamos, N. Mex 275
Morgan, Robert L., Acting Assistant Secretary of Energy for Defense Programs; accompanied by James W. Culpepper, Acting Principal Deputy Assistant Secretary of Energy for Defense Programs; and Dr. James P. Wade, Jr., Assistant to the Secretary of Defense for Atomic Energy 285

FISCAL YEAR 1982 DEPARTMENT OF ENERGY AUTHORIZATION FOR NATIONAL SECURITY PROGRAMS

FRIDAY, MARCH 13, 1981

U.S. Senate,
Subcommittee on Strategic and
Theater Nuclear Forces,
Committee on Armed Services,
Washington, D.C.

The subcommittee met in open session at 8:35 a.m. in room 224, Russell Senate Office Building, Senator John W. Warner (chairman) presiding.

Present: Senators Warner and Thurmond.

Staff present: Paul C. Besozzi, minority counsel; Robert S. Dotson, Frank J. Gaffney, Edward B. Kenney, Ronald F. Lehman, E. George Riedel, and James C. Smith, professional staff members; and Marie Fabrizio Dickinson, staff assistant.

Also present: Dennis P. Sharon, assistant to Senator Goldwater; Chris Lehman, assistant to Senator Warner; Bill Furniss, assistant to Senator Quayle, Jon A. Schreiber, assistant to Senator Denton; Frank Krebs, assistant to Senator Cannon; Greg Pallas, assistant to Senator Exon; and Will Smith, assistant to Senator Jackson.

[The bill S. 846 follows:]

[S. 846, 97th Congress, 1st session]

A BILL To authorize appropriations for the Department of Energy for national security programs for fiscal year 1982 and fiscal year 1983, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1982".

TITLE I—NATIONAL SECURITY PROGRAMS

OPERATING EXPENSES

Sec. 101. Funds are hereby authorized to be appropriated to the Department of Energy for fiscal year 1982 for operating expenses incurred in carrying out national security programs (including scientific research and development in support of the armed services, strategic and critical materials necessary for the common defense, and military applications of nuclear energy and related management and support atcivities) as follows:

(1) For naval reactors development. $279,500,000;
(2) For weapons activities, $2,454,300,000;
(3) For verification and control technology, $48,900,000;
(4) For materials production, $616,200,000;

(5) For defense nuclear waste management, $262,028,000;

(6) For nuclear materials security and safeguards development, $44,300,000;

(7) For security investigations, $23,600,000.

PLANT AND CAPITAL EQUIPMENT

SEC. 102. Funds are hereby authorized to be appropriated to the Department of Energy for fiscal year 1982 for plant and capital equipment (including planning, construction, acquisition and modification of facilities, land acquisition related thereto, and acquisition and fabrication of captal equpment not related to constructon) necessary for national security programs, as follows:

(1) For naval reactors development:

Project 82–N–100, general plant projects, various locations $4,000,000.

Project 82–N–111, materials facility, Savannah River, South Carolina, $15,000,000.

(2) For weapons activities:

Project 82–D–100, general plant projects, various locations $15,800,000.

Project 82–D–103, general plant projects, various locations $16,300,000.

Project 82–D–104, new weapons production installations, various locations, $5,000,000.

Project 82–D–106, weapon assembly facilities, Pantex Plant, Amarillo, Texas, $23,500,000.

Project 82–D–107, utilities and equipment restoration, replacement, and upgrade, Phase III, various locations, $87,500,000.

Project 82–D–108, nuclear weapons stockpile improvement, various locations, $32,200,000.

Project 82–D–109, 155mm artillery fired atomic projectile (AFAP) production facilities, various locations, $35,000,000.

Project 82–D–111, interactive graphics system, various locations, $9,000,000.

Project 82–D–142, north Las Vegas Atlas facilities, Las Vegas, Nevada, $3,600,000.

Project 82–D–146, weapons production and production support facilities, various locations, $8,000,000.

Project 82–D–147, pressure test facility, Savannah River Plant, Aiken, South Carolina, $3,500,000.

Project 81–D–106, weaponization facilities, Ernest Orlando Lawrence Livermore National Laboratory, California, an additional sum of $1,000,000 for a total project authohrization of $7,600,000.

Project 81–D–108, reactor support facilities, Sandia National Laboratories, New Mexico, an additional sum of $1,000,000 for a total project authorization of $10,000,000.

Project 81–D–115, M–X warhead production facilities, various locations, an additional sum of $60,000,000 for a total project authorization of $70,000,000.

Project 81–D–116, utilities and equipment restoration, replacement, and upgrade, Phase II, various locations, an additional sum of $10,000,000 for a total project authorization of $85,000,000.

Project 81–D–120, control of effluents and pollutants, Y–12 Plant, Oak Ridge, Tennessee, an additional sum of $3,400,000 for a total project authorization of $6,400,000.

Project 81–D–133, earthquake damage restoration, Lawrence Livermore National Laboratory, California, an additional sum of $6,300,000 for a total project authorization of $9,300,000.

Project 81–D–134, earthquake damage restoration, Sandia National Laboratory at Livermore, California, an additional sum of $1,700,000 for a total project authorization of $3,700,000.

Project 79–7–o, universal pilot palnt, Pantex Plant, Amarillo, Texas, an additional sum of $5,200,000 for a total project authorization of $12,600,000.

Project 78–16–a, cruise missile production facilities, various locations, an additioinal sum of $80,700,000 for a total project authorization of $98,800,000.

Project 78–17–d, steam plant improvements, Y–12 Plant, Oak Ridge, Tennessee, an additional sum of $1,500,000 for a total project authorization of $27,000,000.

Project 78–17–e, high explosive machining facility, Pantex Plant, Amarillo, Texas, an additional sum of $5,600,000 for a total project authorization of $10,600,000.

Project 77–11–c, 8-inch artillery fired atomic projectile (AFAP) production facilities, various locations, an additional sum of $3,600,000 for a total project authorization of $30,800,000.

(3) For materials production:

Project 83–D–116, general plant projects, various locations, $23,000,000.

Project 82–D–117, plant engineering and design, various locations, $3,000,000.

Project 82–D–118, N plant security and surveillance, Richland, Washington, $4,000,000.

Project 82–D–124, restoration of production capabilities, Phase II, various locations, $126,000,000.

Project 82–D–126, reactor safety and reliability, various locations, $42,900,000.

Project 82–D–127, safeguards improvements, Savannah River, South Carolina, $34,600,000.

Project 82–D–128, plant perimeter security systems upgrade, Idaho Fuels Processing Facilities, Idaho National Engineering Laboratory, Idaho, $4,400,000.

Project 82–D–136, fuel processing facilities upgrade, Idaho Fuel Processing Facility, Idaho National Engineering Laboratory, Idaho, $40,000,000.

Project 81–D–126, pollution abatement facilities—chemical processing plants, Richland, Washington, for an additional sum of $4,300,000 for a total project authorization of $5,300,000.

Project 81–D–128, restoration of production capabilities, various locations, an additional sum of $14,400,000 for a total project authorization of $49,400,000.

Project 81–D–142, steam transfer header, Savannah River, South Carolina, an additional sum of $1,000,000 for a total project authorization of $8,000,000.

Project 81–D–143, L-Reactor Upgrade, Savannah River, South Carolina, an additional sum of $66,000,000 for a total project authorization of $115,000,000.

Project 80–AE–3, steam generation facilities, Idaho Fuels Processing Facility, Idaho, an additional sum of $5,000,000 for a total project authorization of $28,500,000.

Project 77–13–a, fluorinel dissolution process and fuel receiving improvements, Idaho Fuels Processing Facility, Idaho National Engineering Laboratory, Idaho, an additional sum of $50,000,000 for a total project authorization of $199,400,000.

(4) For defense nuclear waste management:

Project 82–N–101, general plant projects, various locations, $11,400,000.

Project 82–N–103, waste handling and isolation facilities, Richland, Washington, $34,450,000.

Project 82–N–104, waste transfer facilities, Richland, Washington, $6,750,000.

Project 82–N–107, rail replacement/Hanford railroad, Richland, Washington, $12,000,000.

Project 82–N–110, plant engineering and design, Savannah River, South Carolina, $10,000,000.

Project 77–13–f, waste isolation pilot plant, Delaware Basin, Southeast, New Mexico, an additional sum of $8,600,000 for a total project authorization of $127,600,000.

(5) For capital equipment not related to construction—

(A) for naval reactors development, $28,000,000;

(B) for weapons activities, $196,500,000;

(C) for verification and control technology, $1,100,000;

(D) for materials production, $73,600,000;

(E) for defense nuclear waste management, $24,472,000; and

(F) for nuclear materials security and safeguards development, $3,700,000.

TITLE II—GENERAL PROVISIONS

REPROGRAMING

SEC. 201. (a) Except as otherwise provided in this Act—

(1) no amount appropriated pursuant to this Act may be used for any program in excess of 105 per centum of the amount authorized for that program by this Act or $10,000,000 more than the amount authorized for that program by this Act, whichever is the lesser, and

(2) no amount appropriated pursuant to this Act may be used for any program which has not been presented to, or requested of, the Congress, unless a period of thirty calendar days (not including any day in which either House of Congress is not in session because of adjournment of more than three calendar days to a day certain) has passed after receipt by the appropriate committees of Congress of notice from the Secretary of Energy (hereinafter in this title referred to as the "Secretary") containing a full and complete statement of the action proposed to be taken and the facts and circumstances relied upon in support of the proposed action, or unless each committee before the expiration of such period has transmitted to the Secretary written notice to the effect such committee has no objection to the proposed action.

LIMITS ON GENERAL PLANT PROJECTS

SEC. 202. (a) The Secretary may carry out any construction project under the general plant projects provisions authorized by this Act if the total estimated cost of the construction project does not exceed $1,000,000.

(b) If at any time during the construction of any general plant project authorized by this Act, the estimated cost of the project is revised due to unforeseen cost variations and the revised cost of the project exceeds $1,000,000, the Secretary shall immediately furnish a complete report to the appropriate committees of Congress explaining the reasons for the cost variation.

LIMITS ON CONSTRUCTION PROJECTS

SEC. 203. (a) Whenever the current estimated cost of a construction project which is authorized by section 102 of this Act, or which is in support of national security programs of the Department of Energy and was authorized by any previous Act, exceeds by more than 25 per centum the higher of (1) the amount authorized for the project, or (2) the amount of the total estimated cost for the project as shown in the most recent budget justification data submitted to Congress, construction may not be started or additional obligations incurred in connection with the project above the total estimated cost, as the case may be, unless a period of thirty calendar days (not including any day in which either House of Congress is not in session because of adjournment of more than three days to a day certain) has passed after receipt by the appropriate committees of Congress of written notice from the Secretary containing a full and complete statement of the action proposed to be taken and the facts and circumstances relied upon in support of the action, or unless each committee before the expiration of such period has notified the Secretary it has no objection to the proposed action.

(b) Subsection (a) shall not apply to any construction project which has a current estimated cost of less than $5,000,000.

FUND TRANSFER AUTHORITY

SEC. 204. To the extent specified in appropriation Acts, funds appropriated pursuant to this Act may be transferred to other agencies of the Government for the performance of the work for which the funds were appropriated, and funds so transferred may be merged with the applications of the agency to which the funds are transferred.

AUTHORITY FOR CONSTRUCTION DESIGN

SEC. 205. (a) Within the amounts authorized by this Act for plant engineering and design, the Secretary may carry out advance planning and construction designs (including architectural and engineering services) in connection with any proposed construction projects.

(b) In the event it is necessary to conduct a plant engineering and design project which was not previously identified in the budget justification data previously submitted to Congress, the Secretary shall notify the appropriate committees of Congress in writing of the details of the project at least thirty days before any funds are obligated for the project.

(c) Subsection (b) shall not apply to any plant engineering and design project which has a current estimated cost of less than $500,000.

FUNDS AVAILABLE FOR ALL NATIONAL SECURITY PROGRAMS OF THE DEPARTMENT OF ENERGY

SEC. 206. Subject to the provisions of appropriation Acts, amounts appropriated pursuant to this Act for management and support activities and for general plant projects are available for use, when necessary, in connection with all national security programs of the Department of Energy.

AUTHORITY FOR EMERGENCY CONSTRUCTION DESIGN

SEC. 207. In addition to the advance planning and construction design authorized by section 102, the Secretary may perform planning and design utilizing available funds for any Department of Energy defense activity construction project whenever the Secretary determines that the design must proceed expeditiously in order to meet the needs of national defense or to protect property or human life.

ADJUSTMENT FOR PAY INCREASES

SEC. 208. Appropriations authorized by this Act for salary, pay, retirement or other benefits for Federal employees may be increased by such amounts as may be necessary for increases in benefits authorized by law.

AVAILABILITY OF FUNDS

SEC. 209. When so specified in an appropriation Act, amounts appropriated for "Operating Expenses" or for "Plant and Capital Equipment" may remain available until expended.

TITLE III—AUTHORIZATION OF APPROPRIATIONS FOR FISCAL YEAR 1983

SEC. 301. (a) There is authorized to be appropriated to the Department of Energy to be available not earlier than October 1, 1982, those sums which may be necessary for fiscal year 1983 for programs set forth in this Act.

(b) All of the provisions which are applicable to amounts appropriated pursuant to other sections of this Act shall apply in the same manner to amounts appropriated pursuant to this section.

OPENING STATEMENT BY SENATOR JOHN W. WARNER, CHAIRMAN

Senator WARNER. Secretary Edwards, we welcome you before the Armed Services Subcommittee on Strategic and Theater Nuclear Forces. I will ask you at this time to introduce those at the witness table with you.

Secretary EDWARDS. This is Mr. Peter Borré, who is our Acting Assistant Secretary for International Affairs and on my left, Mr. Morgan who is Acting Assistant Secretary for Defense Programs.

Senator WARNER. Mr. Secretary, you may proceed.

STATEMENT OF JAMES B. EDWARDS, SECRETARY OF ENERGY, ACCOMPANIED BY PETER BORRÉ, ACTING ASSISTANT SECRETARY FOR INTERNATIONAL AFFAIRS; AND ROBERT L. MORGAN, ACTING ASSISTANT SECRETARY FOR DEFENSE PROGRAMS

Secretary EDWARDS. Mr. Chairman, it is a pleasure for me to testify on behalf of the Department of Energy's national defense program and to discuss the world energy situation and its implications for the national security of the United States.

Our authorization request for atomic energy defense activities for fiscal year 1982 is $5 billion. The Department's major programs included in the authorization are nuclear weapons development and production, nuclear materials production, defense waste management, and the development of naval nuclear propulsion reactors. Later, in closed session, I will address our budget request for those activities, and the Department's Acting Assistant Secretaries, Mr. Morgan for Defense Programs and Mr. Gates, for Nuclear Energy, will be able to answer detailed questions.

ENERGY OUTLOOK

In open session, I would like to discuss briefly the energy outlook for the 1980's including the world oil market outlook, prospects for the development of alternative energy sources to reduce the dependence of the United States and its allies on imported oil, and our ability to deal with future oil supply disruptions. I shall highlight the challenge we face as a Nation and as a leader in the international community to deal with threats to the energy security of the free world.

Mr: Chairman, I read in the press this morning that we were not putting emphasis on contingency planning and I would like to correct that impression because this is one of the No. 1 programs that we have on line and we are putting great emphasis on contingency planning for disruption both of a minor and major nature.

Senator WARNER. Mr. Secretary, also there are reports on a cutback in your staff with which you are going to monitor the major oil firms, if you would like to comment on that. It indirectly bears on what we are addressing this morning, but if you want to use this forum, feel free to do so.

Secretary EDWARDS. Mr. Chairman, I will put it in one short sentence. There shall be no amnesty.

The energy outlook for the next 10 years indicates that imported oil will continue to be a critical, though declining, proportion of the energy requirements of the United States and other developed nations. Our estimates for U.S. oil imports over the next decade range between 4 and 8 million barrels per day (mmb/d). We expect they will most likely remain at between 6 and 7 mmb/d. U.S. domestic energy consumption will increase slowly.

Free world oil production will probably not increase significantly above the early 1980 level of 52 mmb/d. Given increased oil demand in developing and OPEC countries, the world oil market is likely to remain tight over this decade; moreover, it is possible that Free World oil production will decrease. Recently I have seen some signs that, if we can unlock some of these resources that we have locked up in this country, there will be a marked increase in domestic production in this country. I feel somewhat optimistic. I would like to insert that right here as we cast gloom and doom on the waters. There is a little light at the end of the tunnel if we can unlock these resources.

Senator **Warner**. I believe Secretary Watt is testifying before the Energy and Natural Resources Committee in a few minutes and I think he is going to touch on that factor.

Secretary **Edwards**. He started opening the door to increased energy production by opening some of these lands that have hitherto been locked up and been untouchable.

If oil supplies are tight, this could act as a brake on economic growth and impair efforts to promote economic recovery. To release the brake, we need expanded production of alternate energy sources—particularly coal and nuclear as well as domestic oil and gas—and increased efficiency and conservation of energy. There are recent hopeful signs that this will occur.

Even with further progress in energy supply and energy efficiency, the Free World will continue to be dependent upon a few key oil producing nations located in unstable areas of the world. There will be a constant threat that political events or even technical breakdowns could interfere with substantial flows of oil. Today, over one-third of the Free World's oil comes from countries in the Persian Gulf area. Last year the United States received about one-quarter of its imports from that region, while Japan and Western Europe relied on the area for about two-thirds of their oil imports. The Free World's dependence on the Persian Gulf countries is unlikely to change significantly during the 1980's.

OIL MARKET OUTLOOK

The major uncertainty in today's oil market is the continuing war between Iraq and Iran. This conflict initially removed almost 4 million barrels a day of exports from the world market—or about 8 percent of Free World supplies. Saudi Arabia and some other OPEC members increased production by about 1 mmb/d to make up part of the shortfall, and Iran and Iraq have since resumed limited oil exports which now fluctuate between 1 and 2 million barrels per day. These factors, in addition to a decline in consumption, have resulted in a balanced market and a degree of price stability.

It is an uneasy balance, however. While there is reason to be guardedly optimistic that oil supplies will be adequate for 1981-82, this depends on assumptions that the Iraq/Iran war continues to wind down; that other producers, most notably Saudi Arabia, follow favorable production policies; that growth in oil consumption is small; and there are no further disruptions. Any one of these assumptions could prove to be incorrect.

For the rest of the 1980's, the outlook for oil production is not promising, even with the return to more "normal" levels of output in Iran and Iraq and stability in the Persian Gulf. OPEC nations, in particular those in the Persian Gulf have the greatest potential for increasing production. However, OPEC production, largely for internal economic as well as geologic reasons, is not likely to rise above the high point of 1980—about 29 mmb/d. A number of factors could cause it to be even lower. These include a further scaling down of economic development plans, reluctance to accumulate foreign assets, and other possible changes. Moreover, since oil consumption in OPEC nations will surely increase, the amount available for export will be reduced.

Production in non-OPEC developing nations, such as Mexico, Egypt, and India, will increase somewhat over the next 10 years, but increased domestic demand in these and other developing countries with oil production potential will affect the supplies available for export. Additional competition for oil supplies could come from the Soviet bloc, as declining oil production in that area will shift those nations from a net exporting to a net importing position in the 1980's.

With the exception of the United Kingdom and Norway, conventional oil production in the Western developed countries is likely to fall during most of the 1980's, barring unexpected substantial changes in technology or investment. Even if major new discoveries are made, they are not expected to come onstream until the latter part of the decade. In the late 1980's and into the 1990's expansion of enhanced oil recovery and the development of heavy oils, shale oil, and synthetic liquids can offset the decline in oil availability. I must add, however, that any projection of energy supply is subject to error. That is probably the truest statement, Mr. Chairman, that I will make all day.

In the United States, companies in the marketplace will determine how much oil will be produced. It is part of the Government's responsibility to remove needless barriers to exploration and development. We will do what we can, consistent with market principles, to accelerate exploration and development of oil resources in the United States. That is where there is some encouragement, as I mentioned before.

Taken together, these factors point to a decline in imported oil supplies for the industrialized countries throughout the 1980's. We therefore expect to rely increasingly on other energy sources to maintain acceptable levels of economic growth.

Senator WARNER. May I interrupt for just one moment to put in a footnote? With respect to your window of light on the U.S. production, let us put that in a framework of years. Under the most optimistic find, within what period of time could we expect to bring in any new production?

Secretary EDWARDS. Mr. Chairman, I understand there are some outstanding reports across the horizon in the next 6 months to 1 year and it takes 2 to 3 years for these finds to really get into the marketplace. It is not just the U.S. production but there are encouraging signs in the Newfoundland area where there seem to be some new finds.

Senator WARNER. You are talking about the mid-1980's before it reaches the gas pump at the corner?

Secretary EDWARDS. Yes; about the 1985 to 1990 period.

PROSPECTS FOR ALTERNATE ENERGY SOURCES

The outlook for non-oil energy production in the 1980's is brighter than that for oil. Production from these sources in the developed (or OECD) countries alone could increase more than 35 percent—from about 38 million barrels daily of oil equivalent in 1979 to about 52 million barrels daily of oil equivalent by 1990. This significant increase would more than offset a decline in oil availability and expand total energy supplies by nearly 10 percent by 1990. There is a lot of hard work ahead, however, to turn this potential into reality.

NUCLEAR

Our greatest challenge lies with nuclear power. Over this decade, we estimate that nuclear power could increase by the equivalent of 3.5–4.5 mmb/d of oil, and could provide almost 9 percent of the energy requirements of OECD nations. For this to occur, we must stop the slippage of nuclear programs here and abroad. We must work at home and with our allies to overcome the problems—both technical and political—that have severely impeded the growth of nuclear power. The United States should assist its allies by being a reliable supplier of enriched uranium and nuclear power equipment and should reassert its leadership role in the development of new nuclear technologies.

COAL

Coal has more potential than any other source for providing additional energy in the 1980's. The use of coal in OECD countries could expand by the equivalent of 6 mmb/d of oil—or almost the current amount of U.S. oil imports. It could go even higher. U.S. coal production increased by 21 percent from 1977 to 1980; our coal exports increased by 67 percent. Because of higher prices for oil and gas, U.S. coal production is expected to continue to show substantial growth. We also anticipate that U.S. companies will significantly increase their exports of coal during this decade. By doing so they will make an important contribution to the reduction of other nations' dependence upon imported oil.

I might add that coal exports will help significantly with our balance of trade.

Senator WARNER. While we are on national security aspects, coal also helps those countries become less dependent on the Persian Gulf area and other unstable areas and therefore increases their national security.

Secretary EDWARDS. That is correct, Mr. Chairman. That is one reason that I think the Corps of Engineers should go ahead and deepen those harbors for us.

Senator WARNER. I am happy to hear you mention that.

Secretary EDWARDS. We both feel very strongly about that project.

SYNTHETICS AND RENEWABLES

Our policies must also allow the efficient development of those energy sources which are expected to take us through the 21st century—among them, synthetics and renewables. Oil and gas price decontrol will provide significant market incentives for the development of alternative energy sources. The U.S. Government is prepared to help by establishing a climate favorable to private investment and by direct spending in the limited areas where the risks associated with developing a promising technology are too great for the private sector. We have programed $438 million for fiscal year 1982 R. & D. in fossil energy, a large portion of which will be devoted to coal liquefaction and gasification. We are looking to the U.S. Synthetic Fuels Corporation for assistance in industry's effort to commercialize the most promising of these technologies.

GAS

The outlook for gas is mixed. We expect small gains in West European and Canadian output. These gains may be offset, however, if U.S. production declines in the 1980's, as some predict.

Mr. Chairman, I should like to add a little footnote there. These are statistics that are somewhat old and I believe that when they are updated, they will show a marked increase in gas production in the United States this year.

I do not believe U.S. gas production need decline if we are able to bring Alaskan gas on line and, through deregulation, we increase incentives to domestic producers. We hope that gas imports from our two neighbors—Canada and Mexico—will increase; we recognize that this depends on the domestic policies of those nations. Also, the United States is, in general, positively disposed to LNG imports if its regasified price in U.S. markets is consistent with other sources of gas and energy. Europe will probably increase imports of gas from suppliers such as Algeria and Nigeria.

SOVIET GAS

Our European allies have a potential source of additional gas which we find troubling—natural gas imports from the Soviet Union. At present the Soviet Union supplies about 900 billion cubic feet of gas per year (the equivalent of 400 mb/d of oil) to four West European nations: West Germany, France, Italy, and Austria. A new project—the Yamal pipeline—which will tap gas fields in northwest Siberia could double gas deliveries to these nations by 1990.

Overall Western European energy dependence on the Soviet Union will probably not increase since Soviet oil exports—now about 800,000 b/d—will probably be phased down significantly over the next 5 years as Soviet oil production levels out and then declines. Also, even the increased levels of Soviet gas imports will not result in any West European nation, except Austria, relying on the Soviets for more than 5 percent of its energy needs. Nevertheless, this amount of gas could result in increased Soviet leverage over these nations—particularly if there are not effective mechanisms to handle a cutoff, such as gas storage, surge capacity in Western Europe, or the capability to switch to other fuels. We are currently discussing this problem with our allies.

DEALING WITH OIL SUPPLY DISRUPTION

The Free World has suffered three major oil disruptions in the past 8 years—the embargo of 1973–74, the precipitous drop in Iranian production in 1979 following the fall of the Shah, and the interruption of exports due to the war between Iraq and Iran. We were ill-prepared to deal with all three. The policies we had in place even aggravated a difficult situation. The consequences—particularly resulting from the first two—were substantial both at home and abroad.

Any action to defend against the consequences of a shortfall must be international in scope—and each nation must do its part. The United States and its allies must be better prepared to meet disruptions, for as I have indicated, the tightening oil market is likely to persist in this decade and our continued dependence upon imported oil from unstable regions make it likely that future disruptions will occur. I would like to outline for you the direction of our approach to this problem, both domestically and internationally.

DOMESTIC

Higher oil prices stimulate production from alternate sources as well as stimulating greater efficiency. Since 1973, however, the Government of the United States has inhibited the market forces. During disruptions, allocation rather than price was used to manage shortfalls. This approach impaired our ability to deal with the disruptions which occurred in 1973–74 and 1979. More damaging were the long-term consequences of price control. It lowered incentives to produce and conserve energy and it actually subsidized imports—thus increasing our vulnerability and putting greater pressure on world oil prices, which, in turn, adversely affected the United States and other oil importing nations. The immediate decontrol of oil prices insures that signals given to producers and consumers are the appropriate ones.

Decontrol also indicates the general approach this administration will take toward energy problems—whether dealing with short-term disruptions or reducing our long-term dependence on imported oil. We intend to rely on market mechanisms to the greatest extent possible.

We also have begun to accelerate the fill of the strategic petroleum reserve (SPR)—and are doing so in a way that does not put undue pressure on the oil market. The SPR provides an essential mechanism for dealing with supply disruptions.

I have undertaken a comprehensive review of the means necessary to protect our Nation against a wide range of possible disruptions and to carry our share of the burden of any international effort. I expect results from this effort in the near future.

Also, I have created in the Department of Energy the position of Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness. This will centralize the operational responsibility for dealing with the domestic aspects of supply disruptions.

INTERNATIONAL

We intend to work closely with other nations—particularly other industrialized nations and key oil producing nations—to reduce the risk of disruptions and to take coordinated steps to minimize damage when they do occur. We are now participating actively in the International Energy Agency (IEA) effort to reassess the adequacy of its emergency measures. We are reevaluating both the oil sharing system and actions that can be taken during shortfalls that do not trigger the system. The IEA will remain the focus of our international energy efforts. It is an important element in the network of economic, political, and military ties that binds the industrialized democracies together.

Second, we plan to improve the contingency planning in NATO and to make sure that it complements work underway in the IEA.

Third, the United States will continue to build strong, mutually beneficial ties with key oil exporters.

Fourth, we will give considerable attention to the efforts of oil importing developing countries to reduce their oil imports and encourage supply diversification. The private sector should take the lead in this effort; industry has the necessary technology and capital. We will do what we can to facilitate this process.

Fifth, we shall try to counteract the attempts by certain countries to use energy supplies to exert undue political influence over energy importing nations. This is of particular importance when the exporting nations act hostile to our national interests.

We face a substantial and vitally important challenge. It is my most critical task as Secretary of Energy to insure that the United States strengthens its energy security and thus its national security. We intend to facilitate, rather than impede, the rapid development of our own energy resources. But we realize that for the next two decades the United States—and especially its allies—will continue to be dependent upon foreign oil. We can accept this—but only if we are able to counteract the far-reaching consequences of supply disruptions.

I hope to be able to appear before you in the near future to report on the progress of our efforts.

[Supplementary material follows:]

FREE WORLD OIL SUPPLY AND DEMAND[1]

[In millions of barrels per day]

	1980	1985	1990
Supply:			
United States[2]	10.7	9.3	9.2
Other OECD	4.7	5.4	5.7
Other[3]	Negligible	.1	.1
Non-OPEC LDC's	5.7	7.6	8.5
OPEC	27.9	28.8	28.9
Subtotal	49.0	51.2	52.4
Net CPE trade	.9	−.5	−1.0
Total supply	49.9	50.7	51.4
Demand:			
United States	16.9	17.6	15.9
Other OECD	21.3	19.3	18.8
Other[3]	.8	.9	.9
Non-OPEC LDC's	7.7	8.9	10.3
OPEC	2.6	4.0	5.5
Subtotal	49.3	50.7	51.4
Inventory change	.6		
Total demand	49.9	50.7	51.4

[1] Including natural gas liquids, coal liquids, and shale oil.
[2] Including processing gain.
[3] Including Israel, South Africa, and United States territories.

NONOIL ENERGY SUPPLIES IN OECD COUNTRIES[1]

[In millions of barrels of oil equivalent]

	1980	1985	1990
OECD total	38.3	44.5	51.8
Natural gas	15.1	16.1	17.3
Coal	14.9	17.1	20.4
Nuclear	2.9	5.3	7.6
Hydro/geothermal[2]	5.4	6.0	6.5
United States	20.1	22.4	26.5
Natural gas	9.7	9.3	10.2
Coal	7.6	9.1	11.1
Nuclear	1.3	2.4	3.5
Hydro/geothermal[2]	1.5	1.6	1.7
Western Europe	12.1	14.6	16.3
Natural gas	3.7	4.7	4.6
Coal	5.2	5.5	6.2
Nuclear	1.0	2.1	3.1
Hydro/geothermal[2]	2.2	2.3	2.4
Japan	2.3	3.0	3.7
Natural gas	.4	.7	.8
Coal	1.1	1.3	1.7
Nuclear	.4	.5	.6
Hydro/geothermal[2]	.4	.5	.6
Canada	2.8	3.2	3.8
Natural gas	1.1	1.1	1.3
Coal	.4	.4	.5
Nuclear	.2	.3	.4
Hydro[2]	1.1	1.4	1.6
Australia/New Zealand	1.0	1.3	1.5
Natural gas	.2	.3	.4
Coal	.6	.8	.9
Nuclear			
Hydro/geothermal[2]	.2	.2	.2

[1] Including domestic production of natural gas, coal, primary electricity, and net imports of natural gas, coal, and electricity.

[2] Including, where applicable, net electricity trade and other renewable energy sources used for electricity generation.

OUTLOOK FOR WORLD OIL SUPPLY AND DEMAND THROUGH 1982

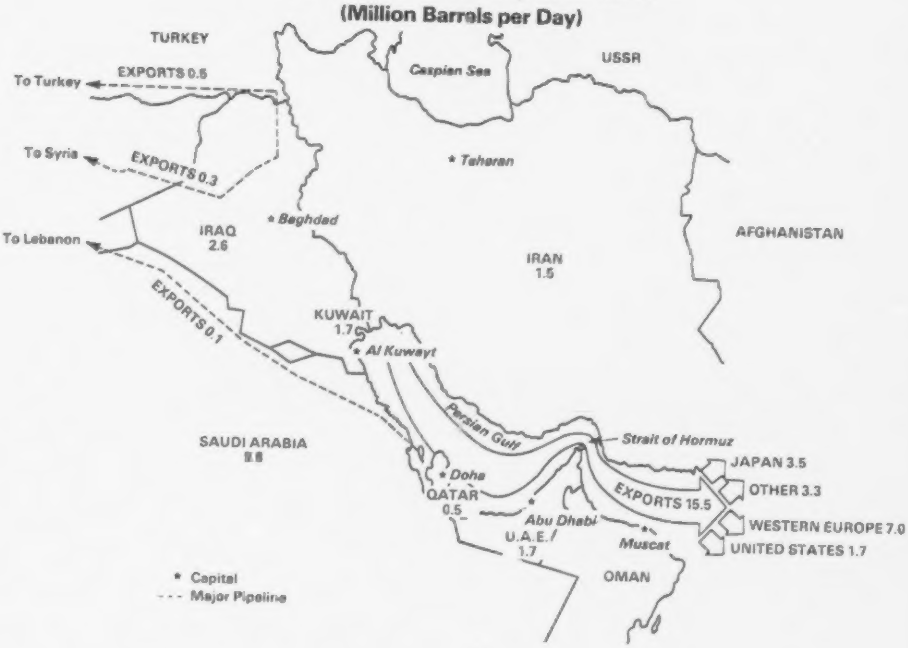
[In millions of barrels per day]

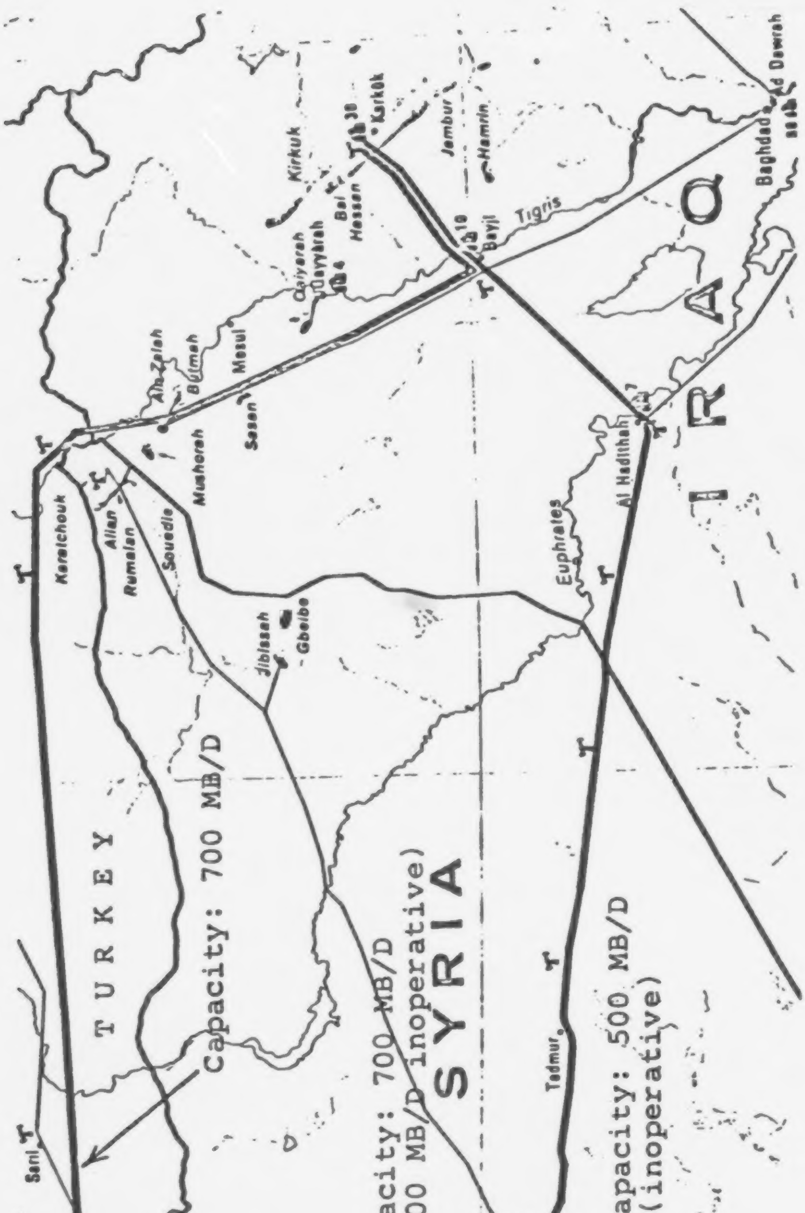
	1980		1981					1982				
	4th quarter	Year	1st quarter	2d quarter	3d quarter	4th quarter	Year	1st quarter	2d quarter	3d quarter	4th quarter	Year
Production:[1]												
United States	10.5	10.7	10.7	10.6	10.6	10.6	10.6	10.5	10.5	10.4	10.3	10.4
Other developed countries	4.5	4.7	4.6	4.7	4.8	4.8	4.8	4.8	4.9	4.9	5.0	4.9
Non-OPEC LDC's	5.9	5.7	6.0	6.1	6.1	6.3	6.1	6.3	6.4	6.6	6.7	6.5
Net CPE exports	1.0	0.9	0.6	0.6	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.3
OPEC	25.1	27.9	25.8	25.6	26.2	26.9	26.1	25.9	26.8	27.2	27.7	26.9
Total	47.0	49.9	47.7	47.0	48.3	49.2	48.2	47.8	48.9	49.4	50.0	49.0
Consumption:[1]												
United States[2]	17.4	17.3	18.1	16.4	16.6	17.8	17.2	17.9	16.5	16.6	17.8	17.2
Western Europe	13.9	13.7	14.0	12.3	12.2	13.9	13.1	14.2	12.3	12.3	14.0	13.2
Japan	5.3	5.1	5.4	4.5	4.4	5.3	4.9	5.5	4.6	4.5	5.4	5.0
Others	13.1	13.2	13.1	13.1	13.1	13.5	13.2	13.4	13.4	13.4	13.8	13.5
World (excluding CPE's)	49.7	49.3	50.6	46.3	46.3	50.5	48.4	51.0	46.8	46.8	51.0	48.9
Inventory change	−2.7	+0.6	−2.9	+1.3	+2.0	−1.3	−0.2	−3.2	+2.1	+2.6	−1.0	+0.1
End of period inventories (billions of barrels)	5.38	5.38	5.11	5.23	5.42	5.30	5.30	5.01	5.20	5.44	5.34	5.35

[1] Includes NGL and processing gain.

[2] Includes U.S. territories.

Persian Gulf Oil
Production and Exports 1980
(Million Barrels per Day)


TURKEY
To Turkey
EXPORTS 0.5
USSR
Caspian Sea
To Syria
EXPORTS 0.3
Teheran
Baghdad
IRAQ
2.6
AFGHANISTAN
To Lebanon
IRAN
1.5
KUWAIT
1.7
Al Kuwayt
EXPORTS 0.1
Persian Gulf
Strait of Hormuz
SAUDI ARABIA
JAPAN 3.5
Doha
QATAR
0.5
EXPORTS 15.5
OTHER 3.3
Abu Dhabi
WESTERN EUROPE 7.0
U.A.E.
1.7
Muscat
UNITED STATES 1.7
OMAN
* Capital
--- Major Pipeline


TURKEY
SYRIA
IRAQ
LEBANON
Mediterranean Sea
Capacity: 700 MB/D
Capacity: 700 MB/D (300 MB/D inoperative)
Capacity: 500 MB/D (inoperative)
Kirkuk
Bai Hassan
Jambur
Hamrin
Qaiyarah
Qayyarah
Baiji
Tigris
Baghdad
Ad Dawrah
Ain Zalah
Butmah
Mosul
Sasan
Mushorah
Euphrates
Al Hadithah
Karatchouk
Allan
Rumelan
Souedie
Jibissah
Gbeibe
Tadmur
Hims
Damascus
Beirut
Sidon
Tripoli
Tartous
Baniyas
Dortyol
Yumurtalik
Gulf of Iskenderun
Bahçe
Sarı
Bulgardag
Mersin
300
800
30
125
128
100
182
250
270

Secretary **Edwards**. Mr. Chairman, I appreciate your allowing me the opportunity to read that statement. I will now open myself to questions.

Senator **Warner**. Thank you, Mr. Secretary.

SOVIET UNION GAS PIPELINE

Your statement with reference to the proposed gas pipeline from the Soviet Union taking the Siberian oil into Western Europe of course is a very troubling situation. It is almost like an umbilical cord from Mother Russia now working its way down into the Western European nations. You are in direct consultation and jointly working with Secretary Haig. What is your objective there?

Secretary **Edwards**. Mr. Chairman, we are torn between two loves. We would like for our European allies to have some alternative source of energy so that they would not be so dependent upon international crude from the Persian Gulf, but on the other hand we would like for these same allies and Western Europe not to be so dependent on the Soviet Union for their energy supplies. We have been reassured by these allies that the energy will be used in a way that will not decrease their ability to respond in case of emergency.

Industries, for example, will not become dependent on these sources of energy and they will be employed for other uses so that it won't impede any effort to continue with industrial production, for example, in case of national emergency. It is disturbing. We hope that they will have some alternate sources from the North Sea, for example, and other areas.

There are some other sources. We hope that they will build a strategic gas stockpile so that they will not have complete dependency. But it is a worrisome situation and we are going to address ourselves to it and work our way through it as best we can.

DOE ATOMIC ENERGY DEFENSE ACTIVITIES

Senator **Warner**. Mr. Secretary, in your statement you indicated a total DOE atomic energy defense activities budget request of approximately $5 billion. How does that figure compare with the original Carter budget request and would you briefly explain any changes you have made to the original budget?

Secretary **Edwards**. Mr. Chairman, this request is $295 million more than the original Carter request.

Senator **Warner**. Now that $295 million was for what specific purposes?

Secretary **Edwards**. May I refer this question specifically to Mr. Morgan?

Senator **Warner**. Yes.

Mr. **Morgan**. Mr. Chairman, I would like to have this reserved for the closed session, if I may.

Senator **Warner**. Fine. I will defer that question then.

The committee is now considering the Defense authorization bill. The Reagan administration amended the Carter request to add $25 billion, a 13-percent increase over the original request by President

Carter. Your requested increase over the Carter budget is substantially less than that in terms of percentage increase. Are you satisfied that you can meet the Defense Department nuclear warhead requirements with your amended budget?

Secretary **Edwards**. I have been assured we can, Mr. Chairman.

Senator **Warner**. A considerable portion of President Reagan's direction is in the strategic area and you are the chief supplier for such an essential component. Even though you fractionally have a smaller increase, you are confident that that is adequate to meet the projections that the President has in mind with respect to the increase of our strategic capabilities?

Secretary **Edwards**. Mr. Chairman, even the former President, after Afghanistan, saw the need for this. I might point out that this represents a 35-percent increase over the 1981 budget. So it is a substantial increase.

Senator **Warner**. I think we need a clearer base line. Which 1981 budget would that be? The Carter budget?

Secretary **Edwards**. The actual 1981 budget was 3.67 billion. The 1982 budget is $5 billion. So there is a substantial increase over that.

Senator **Warner**. Did you wish to add something, Mr. Morgan?

Mr. **Morgan**. No, Mr. Chairman.

Secretary **Edwards**. On the details of these budgets, if you will permit me, I would like Mr. Morgan to answer those questions.

Senator **Warner**. Of course, Mr. Secretary.

ENDORSEMENT OF NUCLEAR POWER

Now, your statement, I am pleased to say, contains a strong endorsement of nuclear power. Can you be more specific with respect to some of the steps by which you are planning to augment America's nuclear power?

Secretary **Edwards**. Mr. Chairman, as you know, we have some increases in our budget for nuclear power. I think the greatest need in this area is to reassure the industry that, when they start moving again, they are not going to get their legs chopped out from under them by irresponsible rules and regulations by the Federal Government. I think there are several things we have to do.

First, an absolute must, we have to start burying nuclear waste and quit talking about it.

Second, we need to move ahead with the Clinch River breeder reactor. We have to show the nuclear industry in America that we are moving ahead in this area.

Third, we need to start reprocessing, thereby closing the back end of the nuclear fuel cycle, so that we can reassure the private sector that we are in fact serious about the nuclear industry. We have to get the Nuclear Regulatory Commission off dead center and start licensing the nuclear plants that we have ready to go right now. I understand that there are about six of them ready to go, just waiting for a license. In the meantime the private sector is paying interest on large quantities of capital investment and not getting any power generated; they can't get any revenues for their investment.

Senator **Warner**. I am very familiar with that situation.

Secretary **Edwards.** We have to shorten the licensing period that they have to go through. Mr. Chairman, except for some funds to get reprocessing moving, these are productive things that won't cost the Federal Government a penny. It won't cost us any money to get the Nuclear Regulatory Commission off dead center. We need a change in personnel over there to get it moving.

As far as the safety of nuclear power is concerned, the U.S. Navy has 1,800 years of nuclear reactor time on all sorts of platforms and in very adverse circumstances all over the world. They have 1,800 years of nuclear reactor time without one death or injury due to radiation. Mr. Chairman, I would put that record up against all the coal fields, all the oil fields, even the forests of this country. If they are going back to burning wood, I will put that safety record up even against the forest industry.

Senator **Warner.** I certainly share that view. I have often said sailors curl up around the nuclear reactor each night to go to sleep in various places in the world. Indeed the record is a good one. If I might say so, we owe that to Admiral Rickover. I happen to be one who has worked with him for many years. He built in that safety margin.

DOMESTIC INDUSTRY

Back however to the domestic industry. Do you think the capital formation in the free market system is such that it can once again resurrect itself and produce the dollars without government inducement?

Secretary **Edwards.** Mr. Chairman, I think that the capital will come if we reinforce these things we are talking about. Nuclear is a way to produce energy but this whole utility industry is in need of reinforcement. The whole industry is hurting.

I might point out that the utility industry in this country represents about 30 percent of the total industrial resources of this country. So, it is a problem when you absorb 30 percent of the total industrial investment in this country in one industry that is really sick and needs some help.

I am not sure that the utility industry itself can create the capital needed because of the system, Mr. Chairman. The Public Service Commissions of the various States, run for election on a platform "I am going to decrease your electric bills." They get elected and they fulfill their promise. They shave electric bills to the point where the company that produces electricity can't get an adequate return on its investment. The investor looks at that possibility versus investing money in U.S. Treasury bills, for example, and there is no comparison.

Why should he invest his money in a risky situation like a utility company when he can buy a government treasury bill and get a much higher return with no risk? As a result, all of these utilities that are investing in the nuclear business and in coal-fired generating capacity are having difficulty raising enough capital. In the end, Mr. Chairman, there will be a desire to nationalize the utility industry of this country. That is really going to cost the taxpayers and consumers.

Senator **Warner.** We are not going to have that happen with this President or this Secretary.

Is the raw materials supply for fissionable materials for domestic needs and military needs projected to be sufficient?

Secretary EDWARDS. Mr. Chairman, I have been reassured that there will be a sufficient supply of uranium to meet domestic needs. Based on current requirements, supplies of nuclear materials for military needs will also be adequate provided that the production initiatives begun in fiscal year 1981 are completed on schedule, that our production facilities continue to operate reliably through this decade, and that no new weapon material requirements are provided by the Department of Defense.

Senator WARNER. Senator Thurmond?

Senator THURMOND. Thank you very much, Mr. Chairman.

I am delighted to have Dr. Edwards, Governor Edwards, Secretary Edwards, with us today. He was the Governor of our State for 4 years and made one of the finest Governors that we have ever had in South Carolina. I think the administration is fortunate to have him in the Cabinet. He is a good manager. He is a proven and dedicated public servant. I am sure that he will do a fine job.

We are also very pleased to have Bob Morgan here, the Acting Assistant Secretary for Defense programs. He has a record of excellence in his work too.

REPLACEMENT PRODUCTION REACTOR

Mr. Secretary, I have just a few questions that I want to ask you. As you know, there are three reactors at the Savannah River plants that produce all the nuclear materials used to make our nuclear warheads. I believe you have plans to upgrade and restart a fourth reactor there?

Secretary EDWARDS. Yes, Senator, we do.

Senator THURMOND. How long do you feel these present reactors can continue to run?

Secretary EDWARDS. Senator, we do not know what the longevity of these reactors will be, but they are quite old. They have recently been inspected very completely and it appears that we can be reassured that they will continue to operate. They seem to be in reasonably good shape. They can continue to operate safely through the 1990's.

Senator THURMOND. There will be a need after 1990 to replace these reactors?

Secretary EDWARDS. Senator, there certainly will be a need to move in that direction, yes.

Senator THURMOND. Last year the Senate Armed Services Committee in its report on your fiscal year 1981 authorization bill urged the Energy Department to get on with plans for one or more replacement reactors. The committee suggested that the replacement reactors go under construction in 1985 with construction completed in 1990. Would you care to comment on your plans and schedules?

Secretary EDWARDS. Senator, we are now in the process of evaluating seven different concepts for replacement reactors. This is scheduled for completion this spring. The selection schedule for 1981 and tentative schedule for the first replacement reactor is as follows. I would just like to summarize by saying that it takes about 14 years from start to finish. The assessment of alternate production facilities will occur during 1980 and 1981. Engineering design will take from 1982 to 1986. Initial construction will start in 1986 and construction should be completed in 1991. The operational checkout will take from 1991 to 1993.

Full power operation should take place in 1993 and the first production should be available in 1994. That is a schedule that I have been given. I wish there were something that we could do to speed that schedule up. I would defer to Mr. Morgan here to comment on the possibility because he is closer to those programs, Senator, than I am.

Mr. MORGAN. Senator, there is a possibility that we could improve that schedule, but we feel that at this point in time the 1982 funding request is reasonable. It is the commitment to the design and the construction of the facility in the 1983 to 1984 period that we believe is critical.

REPROCESSING OF NUCLEAR FUEL

Senator THURMOND. Thank you very much.

Now, Mr. Secretary, turning to another subject, are you reexamining the question of reprocessing of nuclear fuel?

Secretary EDWARDS. Senator Thurmond, are you talking about the commercial reprocessing or reprocessing generally?

Senator THURMOND. I would like to hear your views on both.

Secretary EDWARDS. So far as commercial reprocessing goes, Senator, I feel very strongly that this is one of the things that we have to do. The President is particularly interested in moving into the reprocessing business. He would like to see commercial reprocessing if it can be worked. He wants to see the back end of the fuel cycle closed. I am in complete agreement with him. When the last administration said that there would be no commercial reprocessing it was rather devastating to the industry generally, but specifically to the people who are in the reprocessing business. But he made that proliferation of plutonium. The day that he decided not to allow reprocessing, there were seven or eight countries around the world that went into the reprocessing business. Up to that time we were the leaders. We could have reprocessed the world's nuclear material. We could have controlled their plutonium. We would have known where it was. Most of these countries did not want the plutonium back.

All they wanted was the uranium. When President Carter said we were not going to permit reprocessing there were seven or eight countries around the world that went into business. They are getting the economic gain from reprocessing. Besides that, we have 27,000 spent fuel elements around the country in more than 50 different locations. All of these are radioactive and these utility companies with their other problems are wondering what they are going to do with this material. I am wondering what we are going to do with them.

We can do one of two things. We can bury them in the ground, which means we are burying 50 percent of the energy that is left in them, or we can reprocess them. When we reprocess, we take the fissile material and reduce the volume of the radioactive waste to 10 percent of its original volume. By reprocessing, we will have removed a great percentage of the high level radioactivity from these wastes.

If we can glassify the waste and put it in an insoluble glassified briquet and bury it in an appropriate geological formation somewhere, this will send signals to the world that we are back in the nuclear business. It will send signals to the nuclear industry in this country and I think it will send signals also to the laboring men and women in America that we are interested in creating jobs again for them.

It will get our generating capacity on the move, particularly if we move into the Clinch River breeder reactor and we start using plutonium in the breeder reactor. We can solve this Nation's energy problems, electrical energy problems, for 3,000 years just with the known resources we have available right now. I am in favor of reprocessing, to put it shortly, Senator.

Senator **Warner**. Would the Senator yield now?

To what extent has that policy statement been made public? I have been following this issue carefully.

Secretary **Edwards**. Senator, I have been making it public every opportunity I have had. I have made it public so many times that I am beginning to be thought of as only a nuclear energy man. I would like to go on record right now that I am an energy production man, not just a nuclear energy man. Nuclear energy is one of those small building blocks that we ultimately need to solve this country's energy problem.

In the petroleum products, coal, oil, and gas, we are in fact dealing with a finite resource. One other thing I have learned since I have been on board here is that nobody knows when a resource is going to run out. We know that some day it is going to run out. When it does run out we have to have some alternative energy form and nuclear is one way we can do it. I have tried to make this point and I guess I have not been too successful, Senator, in making it, but it is a point that needs to be told to the whole world.

NUCLEAR ENERGY LEADERSHIP

France has stolen our nuclear energy technology leadership from us. The French representative the other day questioned me. He said "We didn't steal anything." I had to correct him. He stole our leadership in nuclear technology because France moved into reprocessing when we moved out of the business 5 years ago.

Senator, you are interested in exporting coal. I am trying to sell France some coal. The other day when their representative called on me—it was interesting—he said "Mr. Secretary, we are not going to need as much coal in the future as we have in the past because with our breeder technology and our nuclear energy we are going to generate 70 percent of France's electricity needs with nuclear energy in the future. So we are not going to need your coal."

I found that to be quite an interesting statement.

Senator **Warner**. Yes, you appeared before the Energy Committee and you made not quite so strong a statement. It is getting stronger each day. But have you encouraged others in the administration to speak out?

Has the President articulated that policy?

Secretary **Edwards**. The President is well aware of the position.

Senator **Warner**. Has he articulated it?

Secretary **Edwards**. He has to me.

Senator **Warner**. To you privately?

Secretary **Edwards**. Yes, he has to me. And I think in his budget, Mr. Chairman, you will notice that he has budgeted for two waste isolation projects, one commercial, the terminal isolation program, and one defense, the waste isolation pilot project. In the budget he has moved forward with research and development.

Senator **Warner**. I am talking about the reprocessing.

Secretary **Edwards**. He felt that the Barnwell plant should go back into commercial reprocessing if we can stimulate commercial interest in it, Senator. He is in favor of reprocessing. He has told me on several occasions that he is in favor of it.

Senator **Thurmond**. I was going to ask you about the Barnwell plant. I believe the President favors private enterprise going forward with reprocessing. It has been suggested that the Government should take over the reprocessing. Do you have any particular thoughts on the best use of that plant or the various uses to which you think it could be adapted?

Secretary **Edwards**. Senator, as you know, I am always interested in the private sector doing things. I think the private sector can do it more efficiently and more effectively than can Government. But the nuclear industry has taken such a beating at the hands of the previous administration.

The Nuclear Regulatory Commission, for example, has not licensed a new plant in, I don't know how long, but too long. And they are holding up the licenses not on technical aspects of the nuclear industry but purely on philosophy. They don't believe in nuclear, so they are not going to license any plant. That is what it boils down to. If we could break these logjams and move ahead vigorously, I think the private sector would go back into the business, but it is going to be very difficult to encourage them to get back in.

For example, that company was urged by the old Atomic Energy Commission, Mr. Chairman, to build that plant down there in Barnwell. They arranged to get the land and to get the resources going down there. This private industry put $385 million of their stockholders' money into that plant. They got it almost ready to operate and the previous administration said "No, we are not going to permit you to reprocess because of the proliferation issue." From that point on, plutonium started proliferating all over the world and we lost control of it. I will never forget a conversation I had with a Swiss Ambassador who was visiting my State right after the President made that statement about reprocessing. He said "Governor, you know when we were trying to negotiate to buy our fuel rods; we were negotiating with your country and with the Soviet Union."

He said, "Part of that negotiation, Governor, was that once the fuel rods were used and spent, you would take them back, reprocess them for us and send us back the enriched uranium rods in a form that we could burn in a light water reactor. Governor, we didn't want the plutonium, you could keep the plutonium." He said "Now, Governor, since your President won't permit your country to reprocess them for us, we are going to have to look elsewhere," meaning the Soviet Union. He did not say it but he meant that.

"We are going to have to look elsewhere to get our fuel reprocessed. I remind you that all we want back is the uranium. We don't need the plutonium."

Mr. Chairman, that is the kind of proliferation control the previous administration felt was needed.

Senator WARNER. It worked against U.S. interest.

Secretary EDWARDS. It started the proliferation and now several countries are in the process. We don't know where the plutonium is. We don't know where it goes.

In addition to that, Mr. Chairman, think of all the great high technology jobs this country lost when we decided to get out of the nuclear business and France and other countries have gotten into it. France is now exporting the nuclear technology all over the world. They have the leadership in this area. They have taken our know-how and gone to work to use it to capture this leadership. The economic benefits to that country are unbelievable.

Senator WARNER. This is really cutting off your nose to spite your face.

Secretary EDWARDS. Absolutely.

Senator THURMOND. Mr. Chairman, the fact is that the Government did encourage private enterprise to build the reprocessing plant in Barnwell; then the Government turned around and wouldn't let them operate it. Of course as you know for the last few years we have appropriated funds to carry on research there. The question arises now as to what will be done with it immediately. I am just wondering if you don't feel that the Federal Government does have some responsibility to open the Barnwell plant?

Secretary EDWARDS. Senator, anybody with any feeling of fairness and justice, if they know the facts in that case, would have to feel that the Government took advantage of this company in urging them to get into this situation. Of course they got into it with the idea of making some money, getting a return on their investment, and the investment would have been good.

The chairman might be interested to know that if this plant had been permitted to operate, it would have been reprocessing the energy equivalent of a million barrels of crude oil a day. For the previous administration to say no to reprocessing at the Barnwell plant is like saying I don't want another Alaskan pipeline because that is what it gives us.

Senator THURMOND. It is two-thirds of the Alaskan pipeline?

Secretary EDWARDS. It was. They were producing a million barrels of crude oil a day back a few years ago. They may have increased it now, Senator.

That is a prime example of the kind of policies that have led us into where we are today, where the future of this great Nation, the destiny of this Nation is being held in the hands of a few foreign countries, simply because of policies similar to this. This is just one of many that have gotten us into this position.

Senator THURMOND. Yesterday I believe the subcommittee in the House put in an appropriation of about $11½ million. The administration did not recommend that. Do you think the President would veto that?

Secretary **Edwards**. Senator, I work for that man over there in the White House. I am torn between two loves. I will work for him. Whatever he wants I will try to carry out. I haven't gotten any direction. This is a new experience for me, Senator. This is the first time in 30 years that I have worked for somebody else.

NUCLEAR ENERGY A HAZARD?

Senator **Thurmond**. Speaking of nuclear energy, the rumor is throughout the country that it is so dangerous, in fact it is such a hazard that we ought to abolish it altogether. There is a group of people who have been to New Hampshire, South Carolina and other places and picketed these various nuclear plants with the idea of trying to close them down. As a matter of fact, doesn't the record show that during the past no one has been killed in commercial nuclear energy operation?

Whereas, on the other hand, as much as we regret it, about 200 people were killed in coal mines. So, nuclear energy, if proper care and caution are used, is really not the hazard that some other phases of energy work is.

Secretary **Edwards**. Senator, I would like to expand on that. To my knowledge there has never been a life lost in the history of commercial nuclear development from a nuclear accident of any kind. I think that is a pretty good record.

Life is not risk free, Senator, as you know. When you leave here and start to walk across the street, there is a certain calculated risk in it but you don't quit walking across the street.

CERTAIN RISK IN EVERYTHING

One example is down at the Canary Islands. Two or three years ago there were two 747's that collided there and 450 lives were lost. Just because 450 lives were lost in an airplane crash doesn't mean that we should close down and do away with air travel. So there is a certain risk in everything.

As to the risk in nuclear energy, Senator, before you came in I made the point that the Navy has about 1,800 years of reactor operating time without one death or injury due to nuclear radiation. I will put that industry up against any industry in the world. I think last year there were 47 people killed in the State of Maine burning wood. Fire got out of hand and they were burned to death. It was unfortunate. That doesn't mean that the people in Maine should quit burning wood to keep warm. So there are risks in every endeavor we face in life.

Nuclear energy is the cleanest, cheapest, safest form of energy known to man today and I still stand by that statement.

Senator **Thurmond**. As a matter of fact, 50,000 people were killed by automobiles last year.

Secretary **Edwards**. That is right, about 50,000.

Senator **Thurmond**. You don't hear any hue and cry about that. But you mention nuclear energy where no one has been killed and it seems to excite so much interest.

Secretary **Edwards**. There are not many of them left, Senator. They are a dwindling force.

SAVANNAH RIVER PLANT

Senator **Thurmond.** Mr. Secretary, I have been advised that Admiral Rickover is making plans for a new facility at the Savannah River plant. Will you tell us what these plans are and how much is in your budget request to support that program?

Secretary **Edwards.** Senator, can I call on Mr. Morgan?

Senator **Thurmond.** Yes.

Mr. **Morgan.** Senator Thurmond, there is a $15 million request in the 1982 budget for the initial design and planning for a facility in the fuel fabrication process for naval reactors. We are currently reviewing the estimates in the planning and design of that facility and will proceed only after receiving the appropriate authorization and appropriation in the 1982 budget. We do not have the total estimate of cost for that facility yet. We are looking at that right now, Senator.

Senator **Thurmond.** You are hoping to go forward with this forthwith, as I understand?

Mr. **Morgan.** Yes, sir, in the 1982 budget we believe the $15 million is an adequate number.

Senator **Thurmond.** Just how important do you feel this is to the defense of this country?

Mr. **Morgan.** It is most important, Senator.

Senator **Thurmond.** Do you want to elaborate on that? Why is it so important?

Mr. **Morgan.** This is an alternate facility for the fabrication of fuel for the naval fleet and if there is a disruption in the present fuel fabrication facility, it will disable the entire nuclear navy. That is why it is important. We believe that we should have an alternate supply of fuel for the nuclear navy.

Senator **Thurmond.** I want to bring that point out because it seems that some people don't understand how it is tied in so with the work of the Navy and the naval fleet.

Thank you, gentlemen, very much. We are pleased to have you here. I think you have given fine testimony.

I am just hoping that the news media will carry some of the points you have covered this morning because they are paramount to the defense of our Nation.

Thank you, Mr. Chairman.

Secretary **Edwards.** Senator, the press has been very fair and kind to me in carrying my reports and I haven't been misquoted at all in any of the statements I have made. I have been pleasantly surprised at the way the press has carried my statements. I would like to say that publicly, Mr. Chairman, if you will permit me.

Senator **Warner.** I share the same respect for the press.

PETROLEUM SITUATION

I have one question on the petroleum situation. Mr. Secretary, it appears obvious that competition for oil resources will become increasingly intense during the next several years. In your opening remarks as well as my opening comments we both stressed that this has a potential to lead to tensions that in turn could produce armed conflict. How can we hope to, should we say, manage this competition? Does the administration have any plans to develop some international forum to deal with the management of this competition?

Secretary **Edwards**. Mr. Chairman, we have the International Energy Agency that is composed of 21 oil consuming nations around the world. Mr. Borré has represented us recently in that agency. They have contingency plans to help with the management. I understand NATO also has some plans that will help manage these resources in case of national emergency. Maybe Mr. Borré would like to expand since he is the one that handles this for the Department of Energy. He may want to expand on the mechanism we have in place.

Mr. **Borré**. Thank you, Mr. Secretary.

Briefly, Mr. Chairman, without getting too much into the bureaucratics, NATO of course has a petroleum planning committee and addresses the question of military supply during wartime and near wartime situations. The International Energy Agency, which was established in 1974 largely at the initiative of Secretary Kissinger, is really a grouping of the major oil consuming industrialized countries, virtually every one of them except France. France's refusal to join is a political story. But there are ways of cooperating with France through the Common Market mechanism. Since the creation of the IEA, we have experienced two significant oil disruptions, the oil market tightness of 1979 after the fall of the Shah and after last September 22, the consequences of the Iran-Iraq war. One of the consequences that we have drawn from that exercise—and we are not talking about a dramatic wartime event, some of these fall beneath the threshold which would trigger the formal IEA sharing system—is that unless the major players in the world market, the consuming countries, coordinate their efforts, a go-it-alone scramble on the part of three or four countries can push up spot market prices and those prices have a way of working across national borders through increased official OPEC prices, into the United States.

That is the reason why, through diplomacy in coordination with the State Department, we will continue our efforts to cooperate with other consuming countries, because two or three countries cast adrift during an oil shortage can create economic problems for us.

There is also a political dimension to it when you consider that an ally such as Japan is something like 95 percent dependent on oil imports. Of that 95 percent, something like 70 percent comes through the Strait of Hormuz from the Persian Gulf littoral.

Senator **Warner**. Thank you very much.

We will take a 5-minute recess at this point. I am going to ask all persons who do not have the necessary clearances to kindly leave the room. The subcommittee will go into closed session, which will require secret and "Q" clearances.

[Whereupon, at 9:35 a.m. the subcommittee hearing recessed, and the subcommittee moved into executive session.]

EXECUTIVE SESSION

The subcommittee met in executive session at 9:45 a.m. in room 224, Russell Senate Office Building, Senator John W. Warner (chairman) presiding.

Present: Senators Warner, Tower, Thurmond, Stennis, Nunn, and Levin.

Staff present: Frank J. Gaffney, Edward B. Kenney, Ronald F. Lehman, E. George Riedel, James C. Smith, professional staff members, and Marie Fabrizio Dickinson, staff assistant.

Also present: Frank Krebs, assistant to Senator Cannon; Greg Pallas, assistant to Senator Exon; Peter Lennon, assistant to Senator Levin; and Will Smith, assistant to Senator Jackson.

Senator THURMOND [presiding]. Would representatives from DOE please be certain that everyone here has the proper clearances.

Mr. MORGAN. The room is cleared, Senator.

Senator THURMOND. Are you satisfied?

Mr. MORGAN. I am satisfied.

Senator THURMOND. Secretary Edwards, are you to be the first witness?

STATEMENT OF JAMES B. EDWARDS, SECRETARY OF ENERGY, ACCOMPANIED BY DR. JAMES P. WADE, JR., ASSISTANT TO THE SECRETARY OF DEFENSE (ATOMIC ENERGY); ROBERT L. MORGAN, ACTING ASSISTANT SECRETARY FOR DEFENSE PROGRAMS; GEN. MAHLON E. GATES, ACTING ASSISTANT SECRETARY FOR NUCLEAR ENERGY; JAMES W. CULPEPPER, ACTING PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR DEFENSE PROGRAMS; DR. F. CHARLES GILBERT, ACTING DEPUTY ASSISTANT SECRETARY FOR NUCLEAR MATERIALS; MAJ. GEN. WILLIAM W. HOOVER, DEPUTY ASSISTANT SECRETARY FOR MILITARY APPLICATION

Secretary EDWARDS. Senator, I am the first witness I believe. I would like to reintroduce Bob Morgan on my left whom you know and Dr. James Wade, assistant to the Secretary of Defense for Atomic Energy and Gen. Mahlon E. Gates, who is the Acting Assistant Secretary for Nuclear Energy.

Senator, I have not gotten use to using these titles the way I should and I have to check on them but Bob Morgan has been a great help to me in his position of Acting Assistant Secretary.

Senator THURMOND. Senator Warner had to step out, but he suggests that we go ahead. You may proceed now in the order you deem advisable.

Secretary EDWARDS. Senator, I would like to read this statement and then open the floor to any questions that you may have.

Senator, members of the committee, it is a great pleasure to resume my testimony, specifically addressing the Department's atomic energy defense activities. Perhaps more importantly, I want to share my personal beliefs with you concerning some of the challenges we face now and in the future.

Let me begin by citing the four central factors that have shaped the Department's fiscal year 1982 defense budget request in general, which is aimed at strengthening the defense posture of the Nation.

First, the need to execute a vigorous weapons production program;

Second, the need to strengthen our R. & D. base and testing capabilities;

Third, the need to restore and revitalize our aging facilities; and

Fourth, the need to provide for an increased supply of nuclear materials.

While changing priorities in other portions of the Department's budget have resulted in some major reductions, the defense activities share of the budget reflects the administration's commitment to a strong defense. The Department's recent budget review has served to highlight our defense activity responsibilities which clearly justify the requested budget increase.

In this part of my testimony today, I would like to begin by describing the Department's defense mission and scope for the benefit of the new members of the committee. Then I will briefly cover our budget request, amplifying on the factors necessitating the increases we are seeking.

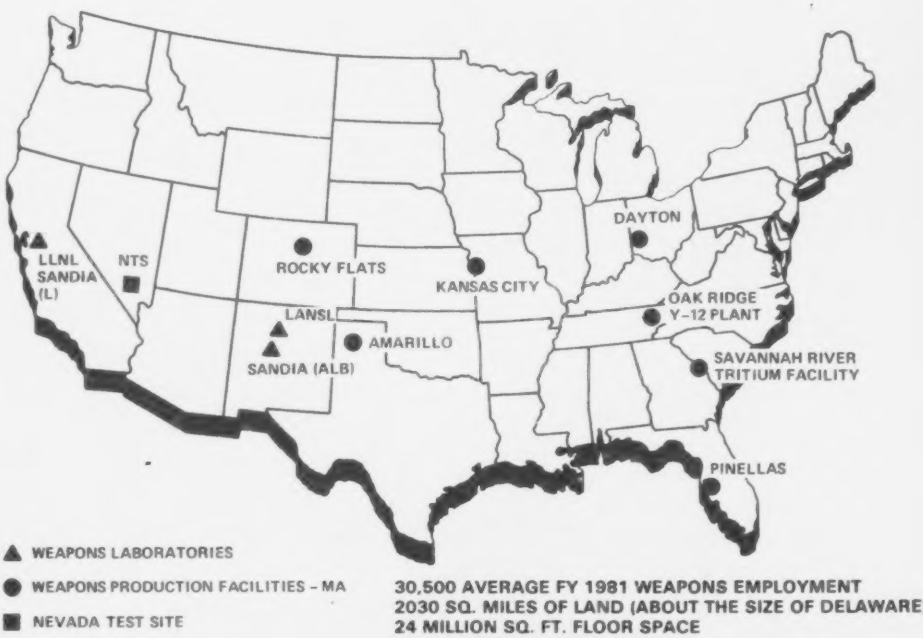
DEFENSE PROGRAMS MISSION AND SCOPE

Two assistant secretaries in DOE share the Department's defense activities responsibility. The Acting Assistant Secretary for Defense Programs, Robert L. Morgan, is responsible for the Department's programs for nuclear weapons development and production, nuclear materials production, defense waste management, inertial confinement fusion, verification and control technology, security investigations, nuclear materials safeguards and security, and classification. Within the Defense activities appropriation, the Acting Assistant Secretary for Nuclear Energy, Mahlon E. Gates, is responsible for the Department's naval reactors development program.

The weapons and nuclear materials production programs are the largest of these program responsibilities. The naval reactors activity, while smaller, is also very important. The other programs provide necessary support for these three, and serve other Government-wide and DOE needs as well.

CHART 1

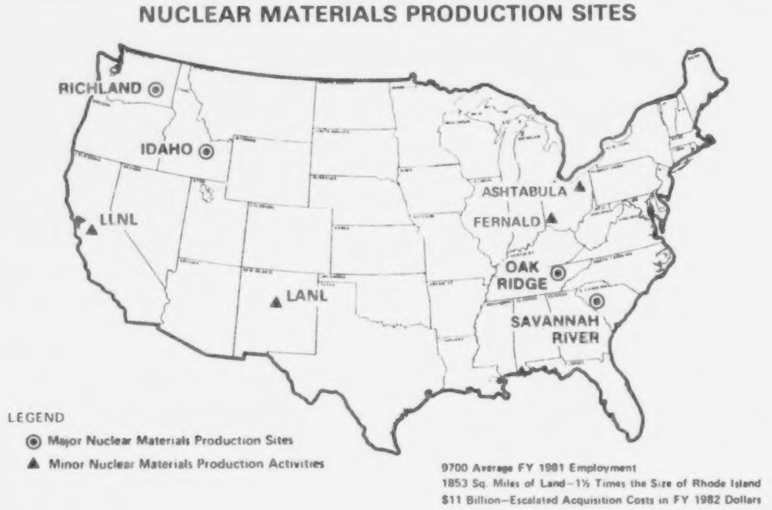
WEAPONS DEVELOPMENT, TESTING, AND PRODUCTION FACILITIES


LLNL
SANDIA (L)
NTS
ROCKY FLATS
KANSAS CITY
DAYTON
LANSL
AMARILLO
SANDIA (ALB)
OAK RIDGE Y-12 PLANT
SAVANNAH RIVER TRITIUM FACILITY
PINELLAS
▲ WEAPONS LABORATORIES
● WEAPONS PRODUCTION FACILITIES - MA
■ NEVADA TEST SITE

30,500 AVERAGE FY 1981 WEAPONS EMPLOYMENT
2030 SQ. MILES OF LAND (ABOUT THE SIZE OF DELAWARE)
24 MILLION SQ. FT. FLOOR SPACE
250,000 ITEMS OF EQUIPMENT
$8.5 BILLION REPLACEMENT COSTS IN FY 1982 DOLLARS

The weapons work is performed at major facilities located in 10 States as shown on the map, chart 1. In fiscal year 1982 the average contractor employment in these facilities will reach 34,500, up from 30,500 this year.

CHART 2

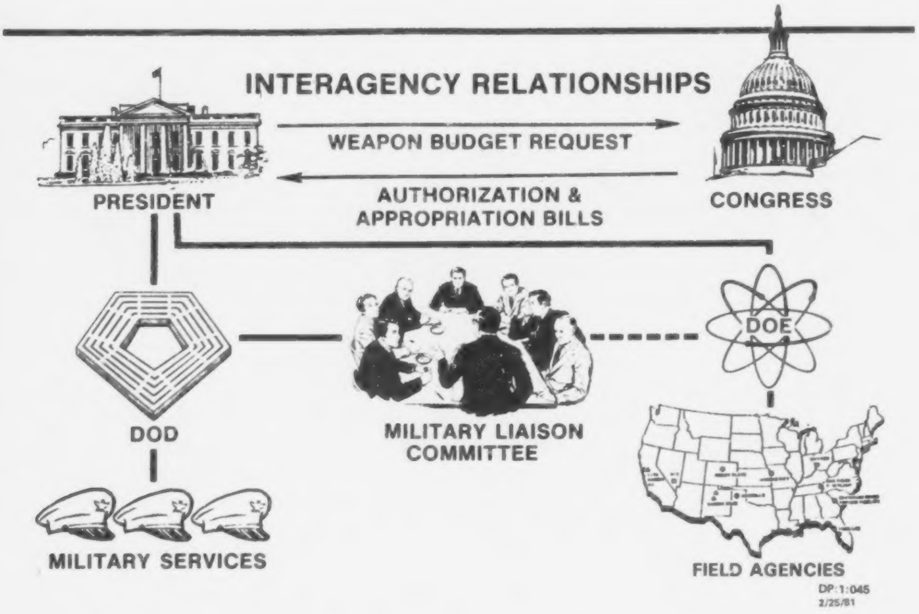

NUCLEAR MATERIALS PRODUCTION SITES

RICHLAND
IDAHO
LLNL
LANL
ASHTABULA
FERNALD
OAK RIDGE
SAVANNAH RIVER
LEGEND
◉ Major Nuclear Materials Production Sites
▲ Minor Nuclear Materials Production Activities

9700 Average FY 1981 Employment
1853 Sq. Miles of Land—1½ Times the Size of Rhode Island
$11 Billion—Escalated Acquisition Costs in FY 1982 Dollars

Similarly, the nuclear materials production complex as shown in chart 2 has major facilities in 4 States, with average fiscal year 1981 contractor employment of 9,700 growing to approximately 12,000 in fiscal year 1982. About $20 billion would be needed to replace these weapons and nuclear materials production facilities today.

CHART 3


INTERAGENCY RELATIONSHIPS
PRESIDENT
WEAPON BUDGET REQUEST
AUTHORIZATION & APPROPRIATION BILLS
CONGRESS
DOE
DOD
MILITARY LIAISON COMMITTEE
MILITARY SERVICES
FIELD AGENCIES

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NUCLEAR WEAPONS AND NUCLEAR MATERIAL PRODUCTION REQUIREMENTS

Now let me say a few words about how our nuclear weapon (and thus our nuclear material production) workload is determined and documented. Each year, the Department of Defense and the Department of Energy, working through the Military Liaison Committee, propose nuclear weapon production requirements by quantity and type in the annual nuclear weapon stockpile memorandum (NWSM).

This document prescribes production and stockpile retirement schedules for 3 fiscal years, preproduction activities and long lead procurement for the next 2 fiscal years, and planning for the following 3 fiscal years, for a total of 8 years.

The memorandum, when approved by the Secretaries of Defense and Energy, is forwarded to the President through the National Security Council. When approved by the President in accordance with the Atomic Energy Act, it constitutes legal authority for our weapons production.

The fiscal year 1981–82 NWSM was approved by President Carter in October 1980. The next memorandum is now in preparation.

THE DEFENSE ACTIVITIES BUDGET REQUEST

Now I would like to summarize the Department's fiscal year 1982 budget request for atomic energy defense activities which is shown in chart 4. As indicated, the fiscal year 1982 authorization requested for the Department's atomic energy defense activities is approximately $5 billion.

CHART 4

ATOMIC ENERGY DEFENSE ACTIVITIES—BUDGET REQUEST

[BA dollar amounts in millions]

	Fiscal year 1981: Congressional—		Fiscal year 1982: Congressional—	
	Authorization	Appropriation	Authorization	Appropriation
Defense programs:				
Weapons activities	$2,422.3	$2,332.7	$3,070.2	$3,196.4
Inertial confinement fusion	(218.4)	(209.7)	(117.0)	(180.2)
Verification and control technology	39.4	39.5	50.0	50.0
Nuclear materials production	704.5	665.7	1,108.4	930.7
Nuclear material security and safeguards	46.7	47.2	48.0	48.0
Security investigations	15.0	15.5	23.6	23.6
Defense waste management	361.9	300.3	369.7	390.0
Subtotal, defense programs	3,589.8	3,401.0	4,669.9	4,638.7
Nuclear energy: Naval reactors development	398.4	303.4	326.5	361.5
Total, atomic energy defense activities	3,988.2	3,704.4	4,996.4	5,000.2

FACTORS UNDERLYING THE BUDGET INCREASE

Four major issues confront us, justifying the $1 billion authorization increase we are requesting in fiscal year 1982. I want to highlight these issues and briefly describe how the Department's budget request addresses them. [Chart 5 deleted.]

As can be seen in chart 5, our nuclear weapons production workload is increasing rapidly and this growth is projected to continue at least through 1988. The production workload is increased not only in the numbers of units to be produced, but also in the different kinds of weapons being built. These increasing requirements will necessitate an increase in contractor employment and an expansion in the capacity of the production facilities and will cause our material costs to rise. Our budget request provides the funding necessary to support the DOD requirements. Let me make note, however, that the nuclear weapons stockpile has been declining in recent years and our increased new weapons production is replacing those older weapons which are being retired. Only a small buildup of the number of weapons in the stockpile is planned in the outyears over what we have today.

Second, as you know, the research, development, and testing functions of the Department of Energy nuclear weapons complex are carried out by our three design laboratories—the Los Alamos National Laboratory, the Lawrence Livermore National Laboratory, and the Sandia National Laboratories. These laboratories have, over the past 30 years, designed and tested 57 nuclear systems which have in the past and the present comprised this Nation's nuclear weapons stockpile. The competence, dedication, and contribution of the men and women of these laboratories to the defense of our country has been historically documented. I must tell you, however, that I am seriously concerned that, over the past 10 years, this portion of the nuclear weapons industry has been allowed to erode—in terms of people, facilities, and programs.

Because of the reduction in overall funding for weapons research and development over the last decade, long-term weapons research programs have been greatly reduced in order to meet the nearer term requirements for new weapons. As this long-term research and development will provide the basic underpinning for the advanced nuclear weapons technology of the 1990's, it is essential that an adequate research and development base be reestablished. Preliminary steps, in the form of a fiscal year 1981 supplemental appropriation request of $51 million, have been submitted to the Congress in order to support an augmented nuclear test program beginning in fiscal year 1982. With your help, I am sure that we can reverse the decline in long-term weapons research activity and place the research, development, and testing portion of the weapons program in a posture to meet the technological challenges of the coming years.

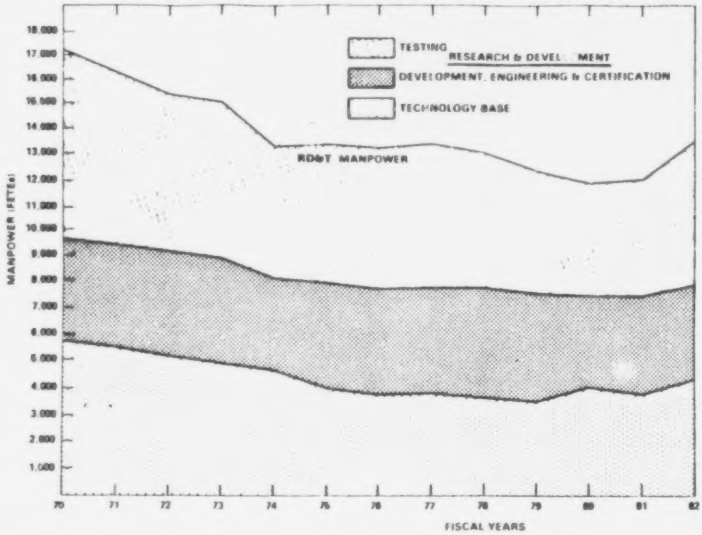
Our fiscal year 1982 request provides for an increase in research and development manpower to 7,850 full-time personnel, an increase of 450 over fiscal year 1981.

Our request also will fund an increased level of testing from about [deleted] tests in fiscal year 1981 to about [deleted] tests in fiscal year 1982, building on the increases afforded by the committee in fiscal year 1981 and our pending supplemental request. This increase in personnel and the higher level of testing will provide substantial improvement in the vigor and vitality of the weapons research, development, and testing effort and help us to more closely match the Soviet efforts. Let me stress that it takes leadtime to build up our testing level.

While we have sufficient authorization, we will not be able to increase to the level of about [deleted] tests without timely appropriation of our $51 million fiscal year 1981 supplemental request.

CHART 6

DEPARTMENT OF ENERGY WEAPONS PROGRAM
RD&T HISTORY – MANPOWER



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The third issue concerns the state of the industrial complex that actually manufactures our Nation's nuclear weapons, and produces the nuclear materials they contain. Because of the underfunding during the last decade for normal replacement of deteriorated equipment and utilities, substantial remedial actions are required in facility restoration to insure that we can meet the high weapons workload during the latter half of the 1980's. Without such remedial action, there would not be sufficient plant capacity or sufficient reliable equipment at a number of points in the production pipeline, and consequent slippages could be expected in weapons production schedules. Efforts to offset this deterioration began with your support in 1980. With the budget request now before the Congress, we will accelerate this restoration work by completing this funding within a total of 6 years.

I believe we should aggressively pursue the restoration and modernization effort—but again I need and solicit your help so that, together, we can provide the means to manufacture the weapons required to meet our future defense requirements.

NUCLEAR MATERIALS

The fourth factor concerns nuclear materials production. Supporting the research, development, testing, and production of our Nation's nuclear weapons and naval reactors is the production and supply of nuclear materials—enriched uranium, weapon-grade plutonium, and tritium. While much of the material needed for new weapons production is supplied by recycle of materials from retired weapons, substantial new material production is required. Once again, to meet these requirements, we must undertake a program to reverse past trends. Chart 8 (chart deleted) shows the current weapons plutonium supply and demand relationship, with a potential shortfall beginning in fiscal year 1985. This shortfall will be avoided if the production initiatives begun in fiscal year 1981 to increase nuclear material production capabilities are continued. Our aging nuclear materials production reactors and their supporting facilities must be upgraded and idle production and processing facilities brought into operation, or we will not have enough nuclear material to manufacture the systems that have been approved for the 1980's. As in the weapons production arena, a nuclear materials restoration and capacity expansion program is underway that will, with your help, insure that enough nuclear material is available for our future systems.

MANAGEMENT OF DEFENSE WASTES

A matter of considerable importance to both the Congress and the Department is the need for continued progress toward the permanent storage of our defense nuclear wastes. The Acting Assistant Secretaries for Nuclear Energy and Defense programs have agreed that a Deputy Assistant Secretary for Nuclear Waste Management will report jointly to nuclear energy and defense programs. Such an arrangement should be responsive to the requirements of the law inasmuch as all defense waste matters will be assigned to ASDP and will hence permit the ASDP to determine and assign appropriate priorities to them. It will also provide continuation of a consolidated waste management program organization. I feel that mutual concern for success and shared efforts can make the arrangement succeed.

CONCLUSION

I want to reinforce my earlier comments concerning the increased importance that this administration places on enhancing the defense posture of our country. Two of the essential elements of that posture, our nuclear weapons and our naval reactors, are provided by the Department of Energy's defense activities. Let me assure you that the needs of the weapons, material production, naval reactors, and supporting programs have my attention. The additional emphasis being placed on these activities in the budget we are presenting to you represents a strong commitment by the administration to meet the defense requirements of this country.

Senator, I appreciate the opportunity to read that statement. We will be glad to respond to any question that you or the committee would like to ask at this time.

Senator THURMOND. I believe Dr. Wade has a statement. Dr. Wade, did you want to insert that in the record?

Mr. WADE. Thank you, Senator Thurmond.

Let me make a few observations.

Senator THURMOND. Without objection, your entire statement will be inserted in the record.

Mr. WADE. Thank you, sir.

[The prepared statement of Mr. Wade follows:]

PREPARED STATEMENT BY HONORABLE JAMES P. WADE, JR., CHAIRMAN, MILITARY LIAISON COMMITTEE (MLC)

Mr. Chairman and Members of the Committee, it is my pleasure to appear before you again to discuss the Department of Defense's nuclear weapons program requirements established in conjunction with the Department of Energy. I would like to highlight for you what has been accomplished over the past year and how recent events might impact within the near term. I would then be pleased to answer your questions.

The fundamental military policy of the United States is deterrence—and, if necessary, defense against any attack, at any level, on U.S. teritory, military forces, or vital interests, or the territory, military forces, or vital interests of our Allies. Deterrence must be effective across the entire spectrum of potential conflict; therefore, the forces designed and deployed must cover that spectrum. We depend on conventional, theater nuclear, and strategic nuclear forces to deter aggression. Theater nuclear forces strengthen and enhance the links between our and our Allies conventional forces and U.S. strategic nuclear forces, and should provide the United States and its Allies a credible capability to respond across the full spectrum of potential conflict.

The role of TNF, and for that matter, our conventional capabilities has become particularly important because of the change in the balance in strategic forces which has occurred over the past decade to the Soviet advantage. To maintain deterrence today and in the future, we must pay increased attention to all elements of our forces. Our programs must ensure that the Soviets do not miscalculate either our purpose or our capabilities.

Credible deterrence is composed of two equally important parts: The first is the demonstrated will and capability to deny objectives; and the second is the demonstrated will and capability to inflict punishment. Possessing only one half of this deterrence equation is not enough. Our adversaries may accept the risk of being denied his objectives if we cannot punish him, or he may accept the risk of punishment if we cannot deny him his objectives. Thus, to me, the perennial argument of "warfighting" versus "deterrence" is based on a flawed logic. A warfighting capability is a fundamental and integral part of deterrence. The Soviets recognize this and posture their forces accordingly. The United States must work at all necessary levels to develop an understanding, particularly with our allies, on this issue. We don't want either a conventional or nuclear war, but must be prepared to fight one if such a war is to be deterred, as we must also be prepared to carry the war to our adversary's homeland. And we must not fear war.

To insure the nuclear portion of our overall military capability is adequate for the task, the Department of Defense and the Department of Energy are currently engaged in a major modernization effort. In the TNF area, this modernization effort is driven by the need [deleted] having improved military effectiveness, safety, security, survivability, and endurance in all environments. On the strategic side, our effort is driven by need to vigorously pursue improvements of our strategic nuclear forces and by continued awareness of the need for improved safety, security, and endurance. This need for improved safety in our strategic systems was emphasized by the TITAN II accident at Damascus, Arkansas, [deleted]. Today new technologies such as insensitive high explosives and improved electrical safety measures are available which could result in greatly improved safety standards. [Deleted]. The purpose of the joint DoD/DoE Stockpile Improvement Program is to address these concerns [deleted]. The DoD must, as a matter of urgency, continue to emphasize modernization [deleted].

Note that I have referred to a major modernization [deleted].

THEATER WIDE TNF MISSION AREA

Our two priority programs in the theater wide mission area are the GLCM and PERSHING II long range TNF systems, agreed to by NATO in December 1979. This modernization decision, of central importance not only for its military effects but also as a symbol of the political determination and cohesion of the Alliance, is currently being implemented. The most critical, if not the most complex, aspect of implementation is the achievement of the planned initial operational capability (IOC) dates. Initial deployment for both systems is scheduled for the end of 1983 in the [deleted] (GLCM) and the[deleted] (PII), and [deleted] for GLCM in [deleted].

Major component testing for the PERSHING II missile has been successful, and the first flight test will occur in April 1982. We expect that [deleted] PERSHING IIs will replace all the U.S. PERSHING IAs in the [deleted] by the end of 1985.

In May 1980, we completed the first flight test of a GLCM from an engineering model. While we are making some technical adjustments to the GLCM program schedule, we are pressing ahead with determination to meet the late 1983 IOC and plan to deploy 160 GLCMs in Europe by the end of fiscal year 1985 and 464 by the end of fiscal year 1988.

The theater-wide mission area also includes sea-based land attack TNF systems. The SLCM program includes the TOMAHAWK nuclear land attack variant (TLAM/N which would give the Navy a more flexible and survivable worldwide theater nuclear force capability with a significant enhancement in operational effectiveness. We are preserving the option for TLAM/N deployment in fiscal year 1984.

The tactical bomb stockpile which supports both U.S. and NATO requirements for theater use is also being significantly upgraded. [Deleted] systems have enhanced safety and security features. The Department of Energy has also requested funds in fiscal year 1982 to begin a Stockpile Improvement Program which will retrofit the older versions of B61 bombs with enhanced security, safety, and command and control features. All forward-deployed tactical B61 bombs will be upgraded by [deleted] under this DoE/DoD program.

BATTLEFIELD TNF MISSION AREA

In the battlefield mission area, there are four important programs under way.

A new 8-inch nuclear artillery projectile, now in engineering development, [deleted] will provide needed improvements. It does not require field assembly; eliminates the need for a spotting round; has increased range (29 versus 18 kilometers); offers [deleted] enhanced radiation/reduced blast (ER/RB); and includes improved fuzing, safety devices and security features. [Deleted.]

A new 155mm nuclear artillery projectile is in an earlier stage of engineering development. This weapon will also provide improvements in range, accuracy, yield, fuzing, and denial disablement features. Last December, this program was deferred so no funds were included in the fiscal year 1982 budget request. The new Administration is reviewing this decision.

The nuclear LANCE surface-to-surface missile is currently deployed with U.S. and other NATO forces. Production of improved LANCE warheads is under way [deleted]. Enhanced radiation/reduced blast features can also be incorporated in these warheads.

The Corps Support Weapon System (CSWS) is an Army artillery missile system with the mission of interdicting surface-to-air missile systems and second echelon enemy ground forces [deleted]. The CSWS is expected to be capable of delivering conventional anti-material, anti-armor, nuclear, and chemical warheads. We currently envision that CSWS will replace the current LANCE.

SEA CONTROL TNF MISSION AREA

The Sea Control mission area includes fleet anti-air, anti-submarine and anti-surface ship systems. Current nuclear systems, the ASROC, SUBROC, TERRIER, and air-delivered bombs [deleted]. As part of our continuing assessment of the future role and utility of naval nuclear systems we have initiated, in conjunction with the Department of Energy, a feasibility study to define a potential warhead for the Anti-Submarine Warfare Standoff Weapon. This is a multi-platform Weapon to be deployed in the late 1980s with either a nuclear warhead or an Advanced Lightweight Torpedo as a payload. [Deleted.]

STRATEGIC NUCLEAR SYSTEMS

Because of our concern for improved [deleted] capability of our strategic nuclear forces, we plan to strengthen all three legs of the TRIAD. The MX, planned for initial operational capability in 1986, is intended to provide a survivable, large throw weight, accurate intercontinental ballistic missile that is effective against the full spectrum of targets, including hard targets. [Deleted.] To further improve the endurance of the MX and to hedge against possible abrogation or modification of the ABM treaty or the unconstrained buildup in Soviet offensive missile capabilities, [deleted].

Our current SLBM capability is composed of POLARIS A3, POSEIDON C3 missiles, and TRIDENT C4 missiles. We are backfitting 12 submarines to carry TRIDENT C4 missiles [deleted].

The Triad capability will be improved by the addition of the air-launched cruise missile [deleted].

A factor with potential impact on future weapons development is the limitation on nuclear testing imposed by existing or proposed test ban treaties. We must be confident that our nuclear warheads will perform as designed. The confidence we have today in the reliability of the nuclear weapons in the stockpile is based on our test program which, besides proving a specific design, helps further our understanding of the explosive process itself. The testing program provides an ongoing basis for verifying the reliability of the stockpile and identifying and correcting problems which might arise as the weapons age [deleted.] One approach to enhancing overall system endurance and to hedge against an unexpected system failure, is to have two warhead designs for each major system. This approach has particular merit under comprehensive test ban constraints, but it imposes additional development burdens on the Department of Energy.

I said previously that we are involved in a major stockpile modernization [deleted]. I think it is important, however, that we restore the flexibility which would enable the DOE to [deleted]. In the last year, we and DOE have been involved in two major studies. There was the Starbird Study which considered all types of resources needed by DOD and DOE to support the weapons program. It attempted the very difficult task of forecasting resource requirements for 20 years. There was also a joint study on the needs for reactor products (plutonium and tritium). The results of both of these studies identified the lack of flexibility that now exists as a result of the decline in budgets, skilled manpower, and facilities since the last period of major nuclear weapon activity in the early 1970s.

Our efforts to replace aging weapon systems and the need to squarely meet a significantly different threat than that of the 70's, both in terms of quality and quantity, will stress the current DOE plant capacity. [Deleted.]

As a result of the studies of the past year, and with the welcome support of the Congress, one of the needed improvements in DOE complex is under way. The three reactors which produce tritium and plutonium for the weapons program are being upgraded and a fourth reactor, which has been in a stand-by status, is also being upgraded to allow future restart. Additionally, actions have recently been taken to start the conversion of the Richland, Washington N-Reactor from production of fuel-grade to weapon-grade plutonium and to upgrade the associated PUREX fuel processing plant for recovery of plutonium from the irradiated N-Reactor fuel. We support these actions.

I remain concerned, however, that sufficient flexibility is lacking in the event of unexpected failure of other portions of the weapon production complex. This situation is further impacted by the age of the DOE weapons facilities which adds an additional degree of risk. In this regard, I strongly support efforts to modernize and upgrade the entire weapons production complex and encourage early planning for and replacement of key facilities, including one or more new production reactors, to ensure adequate tritium supplies beyond the 1990s.

The major emphasis of DOE research and development activities is properly structured to support DOD development programs as first priority. With tight budgets this has been gained at the expense of advanced development and technology base activities. There is an essential need to reverse this trend and restore the appropriate level of effort to programs which expand our fundamental understanding in all areas of nuclear weapons technology.

We must extend our effort to minimize plutonium dispersal hazards. The inclusion of IHE in some weapon systems is a major step toward reducing this hazard. We have asked the DOE to continue investigation of improved safety resulting from [deleted]. We need to address explosive safety for the stockpile as a whole. Additional research in this area is a priority DOD requirement. Continued efforts are necessary towards improving the security, safety, and operational survivability of our stockpile. In a related manner, increased attention is needed toward the problem of the [deleted]. Requirements resulting from the above place additional research and development demands on DOE.

In the broader area of procedural safety improvements, we have made significant progress. On June 14, 1979, during my appearance before the Military Installation Subcommittee of the House Armed Services Committee, I indicated to the then chairman, Congressman Nedzi, that the DOD intended to capitalize on the results of our first joint DOD/DOE Nuclear Weapons Accident Exercise (NUWAX-79) by initiating the planning for a follow-on exercise to be held in 1981 (NUWAX-81). I am pleased to note that the detailed planning is complete at this time, and the exercise will be held in late April 1981 at the Nevada Test Site. This exercise is designed to validate the lessons learned and corrective action generated by the first exercise and provide for expanded participation by national, state, and local civil emergency response agencies.

We have also recently concluded a Memorandum of Understanding between the Department of Defense, Department of Energy, and the Federal Emergency Management Agency that identifies our joint responsibilities and interfaces in the event of radiological accident involving nuclear weapons. Last month, we tested many of these procedures in a Washington level JCS-sponsored Command Post Exercise involving principals of DOD, DOE, and FEMA. In the course of our recent efforts, we have identified other efforts that I consider necessary. We continue to search for new and innovative measures to increase our procedural safety for handling the stockpile to reduce the likelihood of having any weapon experience an abnormal environment.

We are living in a period of increased challenges to the national security of the United States. The nuclear weapons stockpile will continue to play a central role if not dominant. The management and acquisition of nuclear weapons to support national security involves both the DOE and DOD who, within the guides established under the Atomic Energy Act, bring different roles to the process. The development and delivery of a nuclear weapon by the DOE is a carefully coordinated effort to meet established DOD requirements and is done to coincide with the fielding of the weapons system. In this respect, the relationship between the DOE and DOD has been both responsibile and effective and all of of our people have worked to insure that our efforts continue to be responsive to our mutual requirements. Our appreciation of each others problems is especially important because of the uncertainties and concerns associated with the tasks ahead. In this regard, I am reviewing the projections from the approved Nuclear Weapons Stockpile Memorandum to ensure that nuclear weapon planning remains consistent with the DOD systems initiatives now being considered.

Because of the increasing importance of nuclear warhead and resource constraints on the weapon system acquisition process, we are placing increased emphasis on the DOD/DOE relationship. The acquisition of nuclear warheads involves long lead time. To ensure future options, the investment base and underground testing must be strengthened. As I mentioned earlier, [deleted]. The hardware aspects of safety, security and survivability have all taken on increased importance. [Deleted.] Added to the increased Soviet threat, all pose additional requirements to weapon system development.

While we have an ever-advancing technology base, we must continue to carefully assess the actual value of the actions we do take to maximize finite resources. Admittedly, we cannot forecast the longer term needs with accuracy, but over the past year we have made an important beginning in improving our long term planning process to insure we encompass the totality of the issues that confront us in better insuring the most effective and sensible evolution of our nuclear weapons posture.

Thank you.

STATEMENT OF DR. JAMES P. WADE, JR., ASSISTANT TO THE SECRETARY OF DEFENSE (ATOMIC ENERGY)

Mr. WADE. As you are aware from Secretary Edwards' testimony, the Department of Defense and the Department of Energy are involved in a major modernization program to replace [deleted]. Now as indicated earlier, this task should have been commenced quite a few years ago. Therefore, the delay that we have seen over the past several years has made this task even more difficult because it calls for a very major turnaround in the level of effort that had been previously underway in the DOE.

In conjunction with the need for modernization of the nuclear weapons stockpile, we also are facing a parallel task of modernizing the DOE complex. We need to replace our older weapons and do this in conjunction with modernizing the production complex. The task that is in front of the Department of Energy is a tough one, because they are running in parallel on these two important elements of the problem.

The moneys that the Congress provided to us last year, with support for the request for resources this year will put us in a "green" mode. I feel quite confident that, (1) we are going to get healthy and, (2) we are going to succeed in making the stockpile we have currently deployed [deleted].

NUCLEAR MATERIAL PRODUCTION

It is important to note one critical issue that I have been concerned about over the past few years. That is that [deleted]. The three current operating reactors at Savannah are being improved and the standby reactor at Savannah River will be restarted. The N reactor at Hanford will be converted to produce weapon materials and the associated Purex process plant will be restarted. We are doing everything we can to provide additional capacity and it will result in a significant improvement.

I would like to note as we plan toward and modernize the nuclear weapon systems in our total military force that it is important that our weapons system requirements, [deleted].

As we review the new programs that have been recommended as part of the Reagan budget, we are also going to have to further review the ability of the DOE complex to support these new requirements. We have this reassessment under way.

POSSIBLE NEED FOR MORE MATERIAL CAPACITY

I would like to note [deleted]. Its significance will depend in part, on the future of SALT and on the [deleted]. We are reassessing our need. [Deleted] and we may have to come back to you in the future for your additional help.

WEAPON SAFETY AND SECURITY

A second point I would like to make is that one of the highest priority elements in the modernization of our nuclear weapons stockpile is the improvement of the safety and security of our nuclear weapons. As this committee is aware, [deleted] is not a healthy situation.

The DOD has been quite concerned, with the DOE, over the past few years, in this regard. We are turning around fast and working hard with the DOE to address this issue and fix the important pieces as best we can.

I would like to leave the message with this committee that, over the next 10 years, the enhancement of the safety and security of our weapons systems, should receive as high a priority as the need for new weapon technology per se, and new weapon systems in our forces.

ENHANCED RADIATION WEAPONS

Senator **Thurmond**. Secretary Edwards, you are now about to go into production of the Lance warhead and the 8-inch artillery fired warhead which can include an enhanced radiation capability. Would you discuss briefly this enhanced radiation feature?

Secretary **Edwards**. Senator, I am somewhat familiar with it but I believe Dr. Wade can probably give you a better answer to that than I. He is closely associated with this weapon system.

Mr. **Wade**. Let me address the W–79 8-inch artillery system which I believe you are principally interested in. The W–79, AFAP, as it is commonly called, possesses a number of improvements which I would like to mention. The first one is that the range of the round is [deleted] that of the round that is currently in the force. The second is that the round has significantly enhanced safety features. I mentioned earlier that the currently deployed round is about [deleted]. Also, the old round has to have a spotting round fired before the nuclear round can be employed. This would signal the enemy, seeing the spotting round first, that a nuclear round would come next. Finally, the time to ready the new AFAP for firing has been significantly reduced. Those are basically nonnuclear features. In assessing the viability of this round we need to keep those improvement features in mind.

In addition, the 8-inch round has the capability for what is called the enhanced radiation feature. It is a feature that provides significant enhancement in military effectiveness compared with the old round. [Deleted.] Does that answer your question, Senator?

Senator **Thurmond**. What you are speaking about is commonly called the neutron bomb?

Mr. **Wade**. That is the word commonly used in the press. It is unfortunate that that term was ever invented, frankly.

Senator **Thurmond**. What should be the proper term?

Mr. **Wade**. The technical description is enhanced radiation weapons. [Deleted.]

Senator **Thurmond**. Who first used it, the Defense Department or the newspapers?

Mr. **Wade**. Primarily scientists who were involved in developing the weapon. Looking back, you can't blame them. It is just an American habit. You develop something new, it enhances capability, you like to tell people about it, and it then gets into newspapers with all the new descriptors.

ENHANCED RADIATION WEAPON MATERIAL AVAILABILITY

Senator **Thurmond**. Dr. Wade, what are the current plans with regard to producing the necessary materials and components in order to be able to increase the enhanced radiation capability at some point in the future?

Mr. **Wade**. In [deleted] the Lance W–70 warhead will start coming off the production line. [Deleted] the W–79 eight inch round will start coming off the line. [Deleted.] This is in compliance with the public law. [Deleted.]

Senator **Thurmond**. Dr. Wade, perhaps you and Secretary Edwards can comment on the administration's current plans for deploying these enhanced radiation warheads.

Mr. **Wade**. Senator Thurmond, as I indicated before, we are producing both Lance W–70 and the 8-inch W–79 rounds. [Deleted.]

ENHANCED RADIATION WEAPON DEPLOYMENT

Additionally, I would note two things here. [Deleted.]

SOVIET TESTING

Senator **Thurmond**. Secretary Edwards, Dr. Wade, Mr. Morgan, or yourself can answer any of these questions I propound, or anyone else you want to call on. I want to refer to your chart comparing the Soviet and United States testing.

Does this include United States and Soviet tests for peaceful as well as weapon testing?

Secretary **Edwards**. Senator, Mr. Morgan and I both agree we don't know what the Russian tests are, whether they are for peaceful use or otherwise. Mr. Morgan will say what our tests are for since he is closer to that situation than I am.

Mr. **Morgan**. Senator, we have no idea what the Soviet tests are for. We believe they are not peaceful tests. We believe they are weapons-testing as ours is weapons-testing.

To review those numbers, the Soviets in 1978 had approximately [deleted]. In 1979, the Soviets [deleted]. In 1980, [deleted]. We intend to turn that around, of course, by the initiatives we are taking in the budget in 1981 and 1982.

Mr. **Wade**. Senator Thurmond, may I comment also on that issue?

Senator **Thurmond**. Yes.

SOVIET PEACEFUL NUCLEAR EXPLOSIONS

Mr. **Wade**. In our discussions with the Soviets in the earlier negotiations on test ban limitations, it was quite clear that the Soviets were interested in maintaining a very strong and viable peaceful nuclear explosive program. They have been adamant about this program. A few of the nuclear tests that have been identified [deleted] have been in the areas of the Soviet Union which would be consistent with a peaceful nuclear explosive program. The important point is that a nuclear explosion is a nuclear explosion and there are and there can be viable outcomes or impacts from a PNE explosion that are of value to the nuclear weapon program. Any testing that is conducted at a recognized nuclear weapons test site we consider to be a weapons effect test or a nuclear weapons development test. Elsewhere, the question is an open issue.

Senator **Thurmond**. Do you have any comment on the Soviet level of testing?

Mr. **Wade**. In 1978, the Soviet test program [deleted].

The DOD fully supports [deleted] that Secretary Edwards talked about earlier, because they are required in the context of what I described earlier; that is, to modernize our old weapons.

Senator THURMOND. I have one more question and then I want to turn to the other members for questions. Has the Soviet Union violated either the atmospheric test ban or the threshold test ban?

Mr. WADE. First of all, I would like to note that the number [deleted] that is identified in this chart is the number that we have identified, as nuclear tests. [Deleted.] There is an uncertainty in the sense of geology and the pieces that go to make up how we estimate yield. As part of the test ban, there was a provision entailed in that treaty that noted the possibility of several tests per year going over and above 150 kilotons.

Both sides agreed that when you talk about tests of basically new designs, the possibility of having a testing over 150 kilotons is recognized. So, there was an agreement in that regard. I would note here that when you try to maintain the agreement of 150 kilotons and the test explosion comes in somewhere between [deleted]. I don't think that is being very consistent with the terms of the agreement.

Senator THURMOND. There are many people who are concerned about the tests in South Africa and some feel they are rather mysterious tests. Can you have comment on that?

Mr. WADE. The test of September 1979 I don't think yet has been resolved, Senator Thurmond. I think there is a split voice on the matter. There are those who believe that it was an accident. Yet there is a sizable number of highly competent technical people in this country who believe that the Vela satellites and sensor signals we saw from those satellites strongly indicated that a nuclear explosion took place. I personally believe that some further technical review of that matter is in order to at least provide, at least for this administration, a better resolution of that matter. It is a close call in the sense of our understanding of that event.

The thing that bothers me is that if you look at the timing of the event, the place where that so-called event took place, [deleted].

Senator WARNER [presiding]. Senator Stennis?

Senator STENNIS. Mr. Chairman, I am glad to be here this morning. I appreciate the invitation that you sent me. I left another important meeting to be here. I am interested in not just the military phase, Mr. Secretary, which I have always been interested in of course but also the civilian applications. Over the years, the Joint Committee on Atomic Energy was a highly respected group of men. On appropriations, we more or less took their recommendations over the years that laid the groundwork for this work. Then I had the Appropriation Subcommittee hearings on energy generally for civilian use, all phases, program changes, scarcity and so forth, and got very interested in the future of our people, our economy.

I feel like I have been living in the golden age of America with all this abundance of energy from wood to nuclear power, and I don't want it to run out. I want our grandchildren to share it too. So, you gentlemen are sitting in the driver's seat on this.

I, frankly, am not in favor of dismantling the major parts of our Energy Department. I can't claim any credit for the legislation that created it except to support it in every way I could. I think the thing to do now is to improve it, strengthen it and look into the development of several additional sources, improved sources, additional sources of energy. We are certain that we are going to need all of them in time. There is no way around it.

ADEQUACY OF BUDGET

I favor the idea of developing this nuclear field for the creation of further energy. We have to investigate a more perfect energy, solar energy, but that day is not going to come soon. What needs to be done? We have been at this thing for a good while. Dr. Wade, what do you need now that you don't have in the way of money, that you haven't been getting? Do you have the figures now that you really want in the budget? Just be frank about it.

Tell us what it is. If you want to have more, say that too.

Mr. WADE. Thank you for this opportunity, Chairman Stennis. In reference to our nuclear weapons and the posture of our nuclear deterrent forces, the requirements in this regard are DOE needs. That is what we principally are talking about here this morning. I believe, as a result of our work with your committee last year, and again, our requests for fiscal year 1982, that we have indeed turned the complex around in the sense of facing up to the resource needs to modernize both our forces and the complex to do the job. I believe we are now in a green mode; but, I would like to note again one caution, and that is that we are modernizing our total deterrent force posture, our forces as a whole. I mean by this we have to provide the equivalent attention to our theater nuclear forces that we have been giving to date to our strategic nuclear forces.

For example, I would note here that [deleted]. The safety and security features of our old TNF systems have to be addressed.

In that regard, although we are turning on additional reactors that are required to add special nuclear material to our production needs, [deleted]. We are reassessing that matter now as a result of the administration's DOD budget request to the Congress. I would like to hold off, and come back in about 3 months if we feel we have additional need. Right now I believe as far as the DOE weapons program is concerned that the resources are basically adequate to do the job as currently described.

Senator STENNIS. You are holding off 3 months for determination that you may need more funds?

Mr. WADE. Yes, sir, let me review the SNM problem. We are upgrading the three currently operating reactors. We are turning on our one standby reactor. We are going to restore the Purex plant and we are converting the N reactor at Hanford. That basically is [deleted].

ENHANCED RADIATION RESPONSE

Senator STENNIS. Back to this neutron bomb, as I call it. You have covered that in part but what about the European nations that object to it. Has there been any progress beyond the standby agreement we had a few years ago? I think the new Members of the Congress ought to have a special briefing on that and I need one too to bring us up to date.

Mr. WADE. We can bring you up to date on that. One thing about the neutron bomb is that it is a difficult problem for the public to understand, both in its political side and the technical side. I would be delighted to come over and give you and other interested Members a briefing.

Senator STENNIS. I was right in the middle of those things in the debate on the Senate floor. Now has there been any new agreement with these European nations?

Mr. WADE. As of December 1979, there was agreement within NATO to deploy the so-called Pershing II weapon system and the ground-launched cruise missile with planned IOC dates for 1983 for both Pershing and GLCM in the European theater. [Deleted.]

That NATO decision has been made. We are working very hard with firm determination to keep to those IOC's. [Deleted.] It is an important matter from both a technical and policy point of view. [Deleted.]

History has not helped us. We can't change history. The problem in front of us is rather difficult.

Senator STENNIS. Thank you, Mr. Chairman. I would like to submit for the record some questions to the Secretary with reference to his plans about nuclear energy and the proposed handling of waste, and so forth. I will save time by doing it that way, Mr. Secretary.

Senator WARNER. I wish to advise my distinguished colleague from Mississippi that the Secretary has spoken eloquently this morning, most forthrightly and explicitly, on the change of policy of this administration regarding nuclear waste. In particular he gave a good critique of how he felt this change in policy would begin to curtail the proliferation problem worldwide which, in my judgment and I believe the Secretary's, was exacerbated by the polices of the previous administration.

Senator STENNIS. I am sorry I missed his testimony. I will read every bit of it.

Senator WARNER. Chairman Tower, we welcome you here this morning.

Chairman TOWER. I arrived late so I will defer to Senator Levin if he would like to proceed with questions.

Senator LEVIN. Thank you very much, Senator Tower and thank you, Mr. Chairman, for letting me join you this morning. I have a few questions.

INERTIAL CONFINEMENT FUSION

First on inertial confinement fusion. The Congress has been a strong supporter of inertial confinement fusion, first in terms of designing nuclear weapons. ICF has a straight contribution to make in terms of producing those weapons. It has a great contribution. Those are just near-term contributions in the weapons area. Over the longer term, there are civilian uses which, of course, can be assisted greatly by ICF and I think you yourself, Mr. Secretary, have indicated that the Government should support the development of civilian energy research where there is a high risk program and that, of course, fits this.

I am wondering, in light of the strong support we have given and in light of the strong support that the Department of Energy has given to the ICF program, why is it that the Office of Management and Budget cut this program? Has the Reagan administration taken a program funded at $209 million for fiscal year 1981, and for which the transition team recommended at least that level, and as I understand it, for which the DOE recommends a substantial increase in the level of funding—why has the Office of Management and Budget cut that program?

Secretary **Edwards**. Senator, it is a matter of what we can afford. Certainly, this is a very important program. There is no question about that. It is a very fascinating program. The administration feels that we can stretch it out, and still keep it on line. When we get our economy under control we will be in a position to better fund these programs and fund them more adequately than we will be able to do if we continue down this road that we have been on.

It is an important program, Senator, there is no question about that. It is one that I have an increasing interest in since I have been on board and I have read a little bit about it. It piques my imagination. I want to know more about it. It is one of those activities that must be limited by what can we afford.

Senator **Levin**. We have seen substantial increases in the defense budget and I will be supporting large components of that increase. This is a defense item, is it not?

Secretary **Edwards**. It has some applications that could be used for a very important aspect of our defense if it is developed properly, yes.

Senator **Levin**. Isn't the very criticism which was leveled at the Carter budget for shortchanging us on defense programs to be equally leveled at this budget when you cut this program? Mr. Chairman, I want you to notice a substantial cut in the defense program's inertial confinement fusion research which this Congress has endorsed, and which is a program for which the Department of Energy has requested a substantial increase in this year. It has been actually cut dollarwise by the OMB. That does not make any sense.

Senator **Warner**. Is the Senator intending to restore the cut?

Senator **Levin**. Unless I hear some reason for the cut. We have a defense budget that has a substantial increase in it. This is a program which both the transition team and Department of Energy claim has important defense uses. We have been unable to find a reason for this cut. Obviously, dollars are scarce. That is the reason they cut the very program. They make priority decisions. As a matter of fact, ICF research is a hedge against the Test Ban Treaty because of the capabilities of this program to simulate nuclear test offsets. It does not make any sense. There is no explanation I know of coming from OMB except that the dollars are scarce. If that is the test that is going to be applied by OMB we might as well cut every single item in this budget. Is that the only explanation given to you?

Secretary **Edwards**. It has to do with priorities. This is not as high priority as some of the other things we have funded. We have expanded our defense budget by about $295 million over the Carter recommendation. It boils down to the fact that we have to bring the economy under control and this is one of the areas where we can get some money. There are a lot of these programs that I would like to have funded and funded with greater funding than we are funding them presently. But we don't have a strong economy. If we don't get this inflation under control, Senator, we may not have any defense at all before too long.

Senator **Levin**. That is true with every single item in this budget. That can't be a reason for why one item has a high priority and one has a low priority. As I understand it, this is presently funded at $209 million. The DOE requested, as I understand it, somewhere around $250 million. I would think that is a pretty high priority set by the DOE.

Your request was for $250 million. Is that accurate?

Secretary **Edwards**. Senator, our total budget for the inertial confinement is $180.2 million. That leaves a good many dollars, Senator, to work with. It is not as though we are wiping this out. We anticipate that these funds will stretch out the development of this program and keep it going. When we get our economy under control we hope that we can fund this more fully than we have in the past. This is purely a priority situation.

You have to cut a little bit here, a little bit there, to get the budget to the point where we have only $45 billion left in deficits this year. There is no other way we can reduce this inflation.

Senator **Levin**. That is an answer I would expect from Mr. Stockman but my question is to you.

Secretary **Edwards**. That is the only answer I have too, Senator.

Senator **Levin**. That does not give us the priorities. My question of you, Mr. Secretary, is whether or not it is in fact true that the Department of Energy requested $250 million. That represents the DOE's priority, is that true?

Secretary **Edwards**. There is no question we felt this is one of those programs that certainly gave some promise.

Senator **Levin**. What was your budget request?

Secretary **Edwards**. Let me find out from someone who knows a little bit more, if we want to get specific here.

Our request was $236.4 million, an increase from $219.2 in the Carter budget and after negotiations we wound up with $180.2 million.

Senator **Levin**. Thank you.

ENERGY SECURITY

Mr. Chairman, I just have one additional question. Perhaps you can answer this for the record. I wonder if you would first of all agree that energy security is an important part of our national security?

Secretary **Edwards**. When did I agree with that?

Senator **Levin**. I wonder if you would agree with that statement?

Secretary **Edwards**. It is a most important part of our national security.

Senator **Levin**. Have you computed what the impact is on energy use of three or four items? One, the 55-mile speed limit. Two, the energy standards in buildings. Three, the conservation bank elimination and four, the reduction of $750,000 in gasohol and biomass programs. Have there been computations in the DOE of the energy impacts at the margin, or however you want to figure it, of those changes? If you don't have the answer handy, would you submit the answer?

Secretary EDWARD. I will be glad to submit the answers for the record. There have been computations made and this was considered prior to changes that we have made in these programs.

Senator LEVIN. If you will just give us the impact as you have computed it for those four programs that have been either proposed to be changed or have been changed.

Secretary EDWARDS. Are you talking about the building temperature controls?

Senator LEVIN. That was the Executive order which was stricken by the President, and then the 55-mile speed limit issue, which is unresolved, conservation bank elimination in your budget and the gasahol and biomass, a $750,000 reduction.

Secretary EDWARDS. We will be glad to give you those. If you would like we might also add the tax credits in under the new program that will benefit conservation and solar.

Senator LEVIN. The tax credit was in the original budget, in the Carter budget?

Secretary EDWARDS. Not as heavy tax credits as we hope to have with your help and cooperation.

Senator LEVIN. If you would, and that would be useful, include the increase in the tax credit.

Secretary EDWARDS. We will be glad to submit those for the record, Senator.

[The information follows:]

IMPACT ON ENERGY USE

The 55 mph speed limit is estimated to save 160,000 barrels of petroleum per day and reduce fatalities by 6,500 persons per year. Since the 55 mph national speed limit was enacted in January 1974, approximately 400 million barrels of petroleum and 45,000 lives have been saved.

The Emergency Building Temperature Restrictions Program (EBTR) covered more than 2.8 million buildings. Evaluations conducted during 1980 found that 82–84 percent of the buildings inspected were in full compliance of the law. This translates into an estimated 200,000 to 400,000 barrels-of-oil equivalent per day saved by the regulations, depending on the assumptions made (such as climate, what temperature the buildings would be without the restrictions, and how long the buildings are occupied on a typical day).

Admittedly, the program resulted in energy savings. However, it also forced a set of practices on businesses and consumers. Therefore, on 17 February 1981, President Reagan rescinded the regulations declaring that: "Although restrictions on building temperatures may result in reduced consumption of fuel, I have concluded that the regulatory scheme designed to accomplish that objective imposes an excessive regulatory burden and that voluntary restraint and market incentives will achieve substantially the same benefit without regulatory cost." (Proclamation 4820 of 17 Feb. 1981. Federal Register, Vol. 46 No. 33, 19 Feb. 1981)

The Solar Energy and Energy Conservation Bank was established in the Department of Housing and Urban Development, but the Administration has proposed eliminating it from the HUD budget. We believe that the Bank would not have much effect in the marketplace but would impose a heavy bureaucratic cost. As the price of energy rises to its true market value, consumers will have the appropriate incentive to make the investments in solar and conservation measures (many of which are already cost-effective).

The primary rationale for establishing the Bank was to subsidize interest rates so that consumers could afford the capital necessary to make these investments. However, as the President's economic program begins to produce results in decreased inflationary pressure and declining interest rates, it is no longer justifiable for the Federal government to subsidize interest rates on cost-effective measures.

From the standpoint of producing net energy, biomass alcohol fuels production does not contribute much to creating "new" energy. What is achieved is the conversion of solid fuels into a higher quality fuel, i.e., liquid fuels for transportation. Thus, changes in the biomass to alcohol program do not materially affect the Nation's total energy picture.

It is anticipated that there may be a moderate slowing in the very rapid rate of increase in the planned production capacity previously expected for alcohol fuels. This stretch out in new alcohol capacity is occuring at a time when conventional gasoline supplies appear to be far exceeding current demand, thus lessening the immediate need for alcohol fuel extenders. Overstimulating alcohol production capacity now could result in excess alcohol supply and facility underutilization, thus discouraging future expansion when greater alcohol production will ultimately be needed.

Our proposal for the program will provide for an orderly expansion of production capacity and will lay the necessary groundwork through R&D so that the alcohol option can be available when needed.

Currently, existing tax credits for conservation and solar energy will provide an estimated $10.6 billion in subsidies to consumers between now and 1986. This includes $3.7 billion for conservation, $2.6 billion for solar and renewables, and $4.3 billion for alcohol fuels. In addition to these existing tax credits, the Administration's proposed changes in the tax laws to accelerate the cost recovery system will encourage private industry to invest in research and development. Under the proposed accelerated depreciation schedule, machinery and equipment used in R&D could be depreciated in three years.

Senator LEVIN. Thank you. Thank you, Senator Tower.

THEATER NUCLEAR FORCES

Chairman TOWER. Mr. Secretary, I was detained and was not able to be here at the outset of your testimony. I am sorry I missed part of it but I did hear Dr. Wade discussing the TNF modernization.

That is, is it not, Dr. Wade, our first priority in terms of our force modernization in Western Europe?

Mr. WADE. In Western Europe, yes, sir. That is a key point, Mr. Chairman. Some people, in the past, have not understood that American leadership and American primacy is in our nuclear weapons. That is our first responsibility.

Chairman TOWER. It is my view that we should not permit anything to stand in the way of proceeding apace with nuclear force modernization in Western Europe. We have enough problems with the insistence that we proceed along parallel lines with arms control efforts. In fact I do not believe that we can really engage in any meaningful arms control negotiations with the Soviets until we are in the process of modernizing our tactical nuclear forces in Western Europe. It is a very difficult political position for us to be in. [Deleted.]

Secretary EDWARDS. Senator, I will refer that to Dr. Wade who is closer to this program than I am.

ER WEAPONS

Mr. WADE. Mr. Chairman, the production model that we have under way right now has the following features. No. 1 is that in [deleted] the W-70 Lance warhead will start coming off the production line. In [deleted] 8-inch system will start coming off the production line. [Deleted.]

We are then in compliance with the public law requiring us to have the capability for rapid conversion of the ER capability into these rounds. At this moment the administration is reviewing the matter to decide [deleted].

Chairman **Tower**. There is no urgency in our decision to deploy because you can achieve that deployment in a relatively small period of time [deleted].

Mr. **Wade**. As far as adding the ER feature you are right. But I would like to note that what we have deployed in Europe today, the so-called [deleted]. In addition, let me give you an example of the military effectiveness of these systems.

The new 8-inch weapon system using improved conventional munitions will have ranges on the order of 30 kilometers. The new nuclear W–79 round will have a range also on the order of 30 kilometers. If you maintain the old nuclear system and decide to employ it you may have to [deleted]. There are also other features involved with these new systems that are different from the ER. As to ER, I appreciate your important point that the conversion can be made rapidly.

[Deleted.]

Chairman **Tower**. [Deleted.]

Mr. **Wade**. You are absolutely right, sir.

Chairman **Tower**. [Deleted.]

Mr. **Wade**. Yes, sir, you are absolutely correct.

Chairman **Tower**. I believe that there are no more questions but we will submit additional questions to you for the record.

Mr. Secretary and your associates, thank you very much for coming today.

[Questions with answers supplied follow:]

Questions Submitted By Senator John Warner, Answers Supplied By James B. Edwards, Secretary of Energy

WORLD OIL SUPPLY

Senator **Warner**. Mr. Secretary, let me try and summarize the current world oil supply situation. Your statement says that free world production is now 52 million barrels per day and that figure will probably go no higher. What is the current rate of production for the United States and the U.S.S.R.? That means that the remaining free world production is about 42 million barrels per day. How much of that 42 million barrels is produced in the Middle East and who are the major producers?

Secretary **Edwards**. Preliminary figures show that total world production of oil and natural gas liquids (NGLs) for the year 1980 as a whole averaged some 65.5 million barrels per day (MMB/D). Of this total, the Soviet Union produced 12.0 MMB/D, the United States produced 10.7 MMB/D (including processing gains), and Saudi Arabia produced 10.2 MMB/D (including Saudi Arabia's share of the Neutral Zone) The remaining production not accounted for by the three countries above was widely spread out among a large number of countries, with no single country in this group accounting for more than 2.5 MMB/D.

Oil production in the Persian Gulf countries (Iran, Iraq, Saudi Arabia, Kuwait, the Neutral Zone, Qatar, and the United Arab Emirates) during 1980 averaged some 18.6 MMB/D, and total production in the 13 OPEC Member Countries averaged 27.9 MMB/D.

Senator **Warner**. The current situation in the United States is that we produce over 10 million barrels per day, but we consume about 17 million barrels per day—we are therefore import dependent on nearly half of our oil requirement. According to your statement, last year one quarter of our imports came from the Middle East. This current situation is certainly alarming and was brought clearly into focus by the Soviet invasion of Afghanistan and the Iran-Iraq war. How will this situation change in the future? Can you give us your forecast of total U.S. production, consumption and Middle East dependence for 1985? For 1990?

Secretary Edwards. During 1980, the U.S. consumed about 17 million barrels of oil per day (MMB/D). Of this amount, approximately 10.8 MMB/D was supplied domestically and 6.2 MMB/D was imported. The Persian Gulf countries, Saudi Arabia, Kuwait, Iraq, Iran, Qatar, and the U.A.E. provided about 1.5 MMB/D or nearly 25 percent of our total oil imports.

During the 1980's and particularly after 1985 supplies from many of our country's traditionally important suppliers—Libya, Nigeria, Algeria and Venezuela—will probably decline. This means that, in all likelihood, we will continue to be at least as dependent on the Persian Gulf for our imports as we are now. The attached table provides DOE's latest projections for 1985 and 1990 oil supply and demand.

FREE WORLD OIL SUPPLY AND DEMAND[1]

[In million of barrels per day]

	1980	1985	1990
Supply:			
United States[2]	10.7	9.3	9.2
Other OECD	4.7	5.4	5.7
Other[3]	Negligible	.1	.1
Non-OPEC LDC'S	5.7	7.6	8.5
OPEC	27.9	28.8	28.9
Subtotal	49.0	51.2	52.4
Net CPE Trade	.9	−.5	−1.0
Total supply	49.9	50.7	51.4
Demand:			
United States	16.9	17.6	15.9
Other OECD	21.3	19.3	18.8
Other[3]	.8	.9	.9
Non-OPEC LDC'S	7.7	8.9	10.3
OPEC	2.6	4.0	5.5
Subtotal	49.3	50.7	51.4
Inventory change	.6		
Total demand	49.9	50.7	51.4

[1] Including natural gas liquids, coal liquids, and shale oil.
[2] Including processing gain.
[3] Including Israel, South Africa, and United States territories.

SOVIET BLOC OIL SUPPLY

Senator Warner. Lets' discuss for a moment the comparable situation in the Soviet Bloc. They are now producing roughly 12 million barrels per day and consuming 9 million barrels per day. They export some oil to the several Warsaw Pact nations. Are my figures roughly accurate?

The CIA has stated that the Soviet Bloc will become a net importer in the early 1980's. In one of their documents they estimated that slumping Soviet production could result in import requirements of 3 to 4 million barrels per day by 1985. What is your current assessment of the Soviet situation? When will they become net importers and what will be the magnitude of their import requirements by 1985? By 1990?

Secretary Edwards. During the 1980's, we expect that the USSR will experience significant difficulties in all sectors of their energy economy except natural gas. Oil production (currently at above 12.1 MMB/D) is likely to peak and decline. In order to maintain a healthy rate of economic growth and continue present oil export levels to their Communist partners, it is possible that the USSR could require imports of 3–4 MMB/D by 1985. However, we do not anticipate that they will have the requisite hard currency to make purchases of that magnitude and may be compelled to reduce domestic GNP growh while asking their clients to share the shortage. Therefore, it is possible that the USSR may not become a net oil importer in 1985 or 1990. It will be compelled to reduce its exports to the West and may begin to cut back sales to other Communist states. (In 1980, the USSR exported about 3.0 MMB/D with about 1.9 MMB/D of this amount going to Communist countries.) At present, the USSR depends upon oil sales to the West for about 50 percent of its hard currency receipts, and the curtailment or loss of this revenue would have severe implications for the Soviet economy.

It should also be noted that the USSR has the world's largest gas reserves and is seeking to expand use of gas in domestic markets and as a substitute for declining oil sales in hard currency markets. In 1980, the USSR exported about 2.2 billion cubic feet (bcf) per day of natural gas to Western Europe (equivalent to 400 MB/D of oil). If the Yamal pipeline project between Northwest Siberia and Western Europe is concluded, the USSR will be able to supply at least 4 bcf/day of additional natural gas exports to Western markets over present deliveries.

Senator WARNER. Mr. Secretary, competition for oil resources will become increasingly intense during the next several years. Does the Administration have any plans to develop some international forum to deal with this inevitable competition?

Secretary EDWARDS. The United States and other industrialized democracies established the International Energy Agency (IEA) in 1974, for the purpose of obligating its member nations to deal with an international oil disruption in a cooperative, coordinated manner and thus avoid mutually destructive competion for scarce supplies. To ease the impact of a severe supply disruption, the IEA has developed an emergency oil sharing system which, if activated, provides for the allocation of available supplies on an equitable basis. For less severe disruptions, the IEA provides a forum for its members to develop coordinated policies to calm the oil market. The IEA also provides a framework for the 21 member countries to reinforce the efforts to one another to reduce their longer term dependence upon imported oil and particularly to encourage the production and use of alternate energy sources such as coal.

INERTIAL CONFINEMENT FUSION

Senator WARNER. Briefly explain the goals of your Inertial Confinement Fusion Program.

Secretary EDWARDS. Inertial confinement fusion is of interest both for military applications and as a potential source of fusion energy. In the near term, the principal objective of the ICF program is to determine the full potential of inertial fusion for nuclear weapons physics applications. The development of an economic and practical energy source lies further in the future.

Senator WARNER. I understand that your budget amendment reflects a significant reduction in funding from the original Carter budget for fiscal year 1982. What was the original Carter request for the ICF program for fiscal year 1982? What reduction did you make and why?

Secretary EDWARDS. The original Carter budget, comparable to the present Inertial Fusion budget, provided $219,200,000. The Inertial Fusion budget was reduced to $180,200,000. This cut reflects a rescoping of the Inertial Fusion program to concentrate on obtaining an R. & D. deliverable utilizing current facilities and facilities under construction. The objective is to determine the potential of inertial fusion as an energy source for weapons physics and commercial energy applications. This R. & D. doesn't presently envisage the construction of larger laser facilities. The reduction also reflects the best priorization of funding between inertial fusion and other Defense programs within budgets.

Senator WARNER. Your statement touches briefly on the Nuclear Weapons Stockpile Memorandum and the process whereby the President approves the nuclear weapons production plans. As I understand it, this memorandum is not made available to the Congress. In lieu thereof we have requested a report which summarizes the Nuclear Weapons Stockpile and analyzes your budget request in terms of its ability to meet production schedules. That report is very important to our deliberations and was due on March 1, 1981. Can you tell us the status of this report?

Secretary EDWARDS. We notified the Chairman of the Committee that the report would be submitted later than the March 1 due date because of the revisions to the Carter budget by the new Administration. We are finalizing the report and will be sending it to the Office of Management and Budget, Department of Defense, and the Joint Chiefs of Staff for final review shortly. The report will indicate that the Department of Energy's fiscal year 1982 budget request will meet the nuclear weapon production schedules contained in the latest Nuclear Weapon Stockpile Memorandum.

PRODUCING NUCLEAR MATERIAL

Senator **Warner**. Would you briefly summarize the concept of producing nuclear material—plutonium and enriched uranium—by means of laser isotope separation?

Secretary **Edwards**. Mr. Chairman, laser isotope separation processes cannot produce plutonium. They can, [deleted] to make it suitable for weapons by separating out some of the undesirable plutonium isotopes.

The Department of Energy's Advanced Isotope Separation (AIS) processes to produce enriched uranimum are dedicated to producing low enriched uranium for commercial reactor powerplant fuel.

The concept of Laser Isotope Separation (LIS) can be summarized as follows: Molecules containing the desired element (or atoms of the element) can be irradiated by precisely tuned lasers. The color of the laser light is accurately set so that only selected isotopes of the element will absorb the laser energy. This results in the molecule being decomposed (or the atom being charged). The products which are enriched in the selected isotope can then be separated and collected by physical or electromagnetic means.

These general principles of Laser Isotope Separation are applicable both to plutonium or uranium.

Senator **Warner**. How much money have you included in your fiscal year 1982 budget to pursue this technology?

Secretary **Edwards**. The fiscal year 1982 DOE Defense Programs budget includes $25.8 million in budget authority (B/A) for the plutonium isotope separation program. The fiscal year 1982 DOE Nuclear Energy budget includes $86.5 million in B/A for the uranium isotope separation technology program.

Senator **Warner**. How mature is this technology? Are you confident that a pilot plant could be built now without further research?

Secretary **Edwards**. I am confident that a plant can be built, however, further development and small scale isotope separation demonstrations will be needed before a plant can be built. Our schedule for development will lead to a pilot plant in 1985 and a production plant by 1988.

Senator **Warner**. What are the proliferation issues surrounding this process?

Secretary **Edwards**. Since the plutonium LIS technology would not create any new plutonium, or alter a country's ability to produce various grades of plutonium in a reactor, this technology would have little impact on the ability of a country that is beginning to develop nuclear weapons to obtain plutonium and to produce at least crude nuclear weapons. However, the plutonium technology could be applied to separate isotopes of uranium, and so in that sense, there is a proliferation concern, as with any uranium enrichment process.

Senator **Warner**. Could this process be accelerated with increased funding?

Secretary **Edwards**. The current fiscal year 1982 funding of $25.8 million would enable DOE to demonstrate plutonium laser isotope separation (LIS) technology on an engineering scale in a pilot plant [deleted] by fiscal year 1985 and to have a plutonium LIS demonstration production plant online in fiscal year 1988.

Generally speaking, the program is being pursued vigorously toward the fiscal year 1988 operating date for a production plant. It would be possible with increased funding in fiscal year 1982 and beyond to accelerate the date that a production plant could be online.

Senator **Warner**. What steps are you taking to insure that you have a sufficient supply of special nuclear materials to meet your production requirements in the middle 1980's?

Secretary **Edwards**. DOE has undertaken the following production initiatives to increase the supply of reactor products (plutonium and tritium):

Conversion of N Reactor (Richland, Washington) from production of fuel-grade to weapon-grade plutonium.

Upgrading of the PUREX fuels processing plant (Richland, Washington) to allow recovery of plutonium from irradiated N Reactor fuel.

Upgrading of L Reactor (Savannah River, South Carolina) to allow future restart.

Restoration of the four existing production reactors and other nuclear materials production facilities to offset the loss in productivity experienced over the past decade.

Production of high purity plutonium at Savannah River for blending with low purity plutonium to yield additional weapon-grade plutonium.

Fiscal year 1981 funds have been provided for these production initiatives. Funds to continue these initiatives have been included in the fiscal year 1982 congressional budget submission. The increased production expected to be gained from the above production initiatives will allow DOE to meet weapon program requirements through 1988, as projected in the current Nuclear Weapon Stockpile Memorandum, signed by President Carter in October 1980.

Senator WARNER. Are you confident that these initiatives can provide the needed materials; are there other initiatives that would provide a hedge against uncertainty?

Secretary EDWARDS. These production initiatives are adequate to provide the needed materials under the following assumptions:

1. that the current production reactors and facilities continue to operate as planned without major breakdowns;

2. that the new initiatives described in the answer to the previous question can be started on the planned time scales; and

3. that no new weapon requirements are provided by the new Reagan administration.

One possibility should increased requirements develop, would be to utilize higher productivity cores in the Savannah River, South Carolina reactors to further increase plutonium availability.

DEFENSE NUCLEAR WASTE

Senator WARNER. Would you briefly categorize defense nuclear waste and give the committee some feel for the volume of each category of waste?

Secretary EDWARDS. Defense nuclear wastes are broadly classified into four categories. These are high-level waste (HLW), transuranic waste (TRU), low-level waste (LLW), and airborne waste (ABW).

Defense HLW results from the chemical processing of production nuclear reactor fuels. It is separated in the form of a radioactive, acidic liquid during the steps to extract and purify plutonium and uranium from the irradiated actinides which are not separated out during reprocessing. Because of the corrosive nature of the acidic HLW, it is made alkaline before storage in underground tanks at Hanford and Savannah River. After aging, cooling, and evaporation of excess water, the HLW consists of three fractions: liquid, crystalline salt cake, and sludge. At the Idaho facility, HLW is stored for short periods in stainless steel tanks, after which it is calcined to a dry granular solid and stored in bins. The present volume of defense HLW amounts to approximately 282,000 cubic meters.

Defense TRU waste is waste material containing transuranic elements, mainly plutonium and uranium-233 in excess of 10 nanocuries per gram of waste. TRU includes chemical process residues, discarded equipment and tools, paper, clothing, glass and contaminated soil. Prior to 1970, about 332,000 cubic meters of TRU were buried. Since 1970 TRU waste has been stored in engineered facilities. The waste is retrievable for at least 20 years after storage, so that it can ultimately be recóvered and processed for disposal in a repository. Presently, about 55,000 cubic meters of defense TRU are in retrievable storage.

Defense LLW includes all radioactive waste that is not HLW or TRU. LLW is produced when radioactive materials are handled or processed, and consists of a variety of materials including trash, paper, plastics, protective clothing, discarded equipment, and liquids. Solid LLW is disposed of by shallow land burial. Liquids are solidified before burial. To date, DOE has disposed of about 1,780,000 cubic meters of defense LLW.

Airborne waste is gaseous waste contaminated with radioactive materials generated during nuclear material processing and handling activities. The gas is treated using techniques such as filtration and scrubbing. It is then monitored and released under controlled conditions or retained for further use.

LONG TERM PROCESSING AND DISPOSITION OF WASTE

Senator WARNER. For each category of waste discuss briefly your current programs for the long term processing and disposition of the waste.

Secretary EDWARDS. The airborne waste technology development efforts for particulates and gaseous radionuclides include improvement of filter life and recovery methods, development of immobilization into a stable form, and storage and/or disposal of packaged waste. A pilot scale demonstration of an integrated off-gas treatment system is expected by 1990.

The high level waste objective of the Department of Energy program for defense waste programs at Savannah River, Hanford, and Idaho, is to develop and select an option for each site, and to design, construct, and operate facilities for its implementation. Generic options for each site include continuation of storage on site, as a long-term option, on-site stabilization, retrieval from tanks (or bins) and immobilization of the high-level waste for disposal in a geologic repository.

The current program concentrates resources on implementation of a long-term program at one site, the Savannah River Plant. The reference option is retrieval and immobilization in borosilicate glass for repository disposal. This includes construction of a Defense Waste Processing Facility. Construction of Stage I of the facility is expected to begin in fiscal year 1983. One alternative to borosilicate glass as a final waste form will be selected for intensive development in fiscal year 1982. The long-term program at the other two sites will be deferred until the Savannah River program is well underway.

The shallow land burial of low-level waste is an established practice for the disposal of waste generated from Department of Energy programs. The current program includes stabilization of waste burial sites and development of technology to protect public health and safety, meet applicable criteria and standards, and optimize the future low-level waste management system.

Transuranic wastes generated by Department of Energy programs are stored at six Department sites—Savannah River, Hanford, Idaho, Oak Ridge, Los Alamos, and Nevada. The long-term program strategy consists of: continue storage of defense transuranic wastes at Department of Energy sites; reduce waste generation; develop standards and criteria for disposal; develop technology and facilities for retrieval, processing, and immobilization; and select and implement a long-term option for transuranic wastes at each site.

The current program emphasizes implementation of a long-term program at only one site, Idaho. The reference option for stored transuranic waste at this site is retrieval, processing, and immobilization for repository disposal. A Transuranic Waste Treatment Facility has been proposed for the processing step and a full scale nonradioactive demonstration of the reference process being considered for this facility is supported in the fiscal year 1982 program.

WASTE ISOLATION PILOT PLANT

Senator **Warner**. What is the administration's position on the Waste Isolation Pilot Plant project? How much money is in your budget for fiscal year 1982 to proceed with this facility?

Secretary **Edwards**. The fiscal year 1982 budget submitted by the Reagan administration provides funding of $48.7 million to allow the project to be continued. Fiscal year 1981 funds, which were deferred by the previous administration have also been released so construction of the initial exploratory shaft can begin this summer.

Questions Submitted by Senator Carl Levin, Answers Supplied by James B. Edwards, Secretary of Energy

WEAPONS LABORATORIES

Senator **Levin**. On Pages 4–5 of your statement, Mr. Edwards, you refer to the heart of our national nuclear weapons research program—the three national weapons laboratories—in the following manner: "I must tell you, however, that I am seriously concerned that over the past 10 years this portion of the 'nuclear weapons industry' has been allowed to erode—in terms of people, facilities and programs".

On Page 8, you conclude by stating: "I want to reinforce my earlier comments concerning the increased importance that this administration places on enhancing the defense posture of our country. Two of the essential elements of that posture, our nuclear weapons and our naval reactors, are provided by the Department of Energy's defense activities. Let me assure you that the needs of the weapons, material production, naval reactors, and supporting programs have my attention."

Mr. Edwards, is it not true that the Inertial Confinement Fusion (ICF) program of the Department of Energy has significant near-term benefits for our nuclear weapons [deleted] and production programs?

Secretary **Edwards**. Progressive refinements in weapon [deleted] technology evolve in part from studying the physics of burning inertial fusion targets on a laboratory scale. Similarly, the radiations emitted from an inertial fusion target are qualitatively similar to those emitted from a weapon and can be used to simulate weapon environments. Additionally, inertial fusion experiments can be used for modeling various effects associated with atmospheric nuclear detonations and as an aid to development and [deleted]. The most significant near-term benefits for the Nuclear Weapons [deleted] program will require the generation of large amounts of energy from target burn. It is anticipated that one or more of the facilities under construction will result in pellet ignition, a necessary condition for the generation of large amounts of energy.

INERTIAL CONFINEMENT FUSION

Senator **Levin**. Secretary Edwards, let me read you the explanation Congress was provided last year as to the important contributions the ICF program makes to our nuclear weapons development and production program:

"The lasers currently being used in ICF research are also being used to make measurements of the physical properties of materials in regions of high temperature and pressure. These measurements are applicable to the modeling of some aspects of nuclear weapon performance [deleted].

"Study of the behavior of ICF pellets will have potential applications to the study of nuclear weapon physics, the modeling of some aspects of nuclear weapon performance, and the development and proof of some features of computer codes for nuclear weapons.

"In the future, if sufficiently large nuclear energy releases can be obtained from pellet fuel burn, it should be possible to simulate some of the effects of nuclear weapons (now simulated using other techniques) for the study of the vulnerability of weapon system components to such effects. Such nuclear energy releases may also have limited applicability to the simulation of some of the phenomena resulting from atmospheric and high altitude nuclear explosions."

Do you not think that this research is important to our building better, more effective nuclear weapons?

Secretary **Edwards**. Inertial fusion experiments are potentially valuable in improving our understanding of the performance and effects of nuclear explosives. In concert with research and testing conducted by the weapons program, improved weapons can be designed which are safer, more reliable, and more effective for specific uses.

Senator **Levin**. The computer codes we use in designing and building our nuclear weapons are an essential component of this process to make effective weapons. Does it not make sense that verifying these codes should be an important consideration in developing these weapons?

Secretary **Edwards**. Highly sophisticated computer programs are used in the design of nuclear weapons. These programs include all known essential parameters ranging from nuclear interactions and material responses to weapons effects. Each parameter is continually updated with improved and more precise data as they become available through laboratory experiments and full-scale nuclear and non-nuclear tests. The ICF contribution to the weapons [deleted] program is based on the long-term promise of providing some of these improved data relative to a few of the parameters used in the weapon program. In the near term, however, other means, as explained above, are being pursued to assure that the best achievable and most accurate data are available for use in the [deleted] nuclear weapons.

VULNERABILITY OF NUCLEAR WEAPONS

Senator **Levin**. Another important consideration in the construction of our nuclear weapons is how well they survive against the effects of nuclear explosions caused by either our weapons which preceded them to targets, or by possible enemy ballistic missile defenses. Therefore, we try to make our nuclear weapons "hardened" as much as possible against such effects. Don't you think that the study of the vulnerability of our nuclear weapons to nuclear effects should be a high priority item in our nuclear weapons development programs? Does it make good "national security" sense to reduce the budget of a research program which could contribute to making our nuclear weapons more survivable and thus more effective?

Secretary **Edwards**. Efforts to minimize the vulnerability of our nuclear weapons to both hostile and collateral weapons effects are given a high priority within the nuclear weapon design and development programs. Vulnerability assessments are performed and "hardening" techniques are applied to each weapons system prior to its entry into the stockpile. These steps are accomplished through modeling of the weapons effects of interest, testing at both component and systems levels, and the development of new components and materials where necessary.

The ICF contribution to studies of vulnerability of nuclear weapons are based on the long-term promise of providing a realistic simulation of the nuclear radiation environments of particular interest. Realization of inertial confinement fusion could therefore provide a partial vulnerability testing capability. In the near term, however, recent advances in other weapon simulation technologies are being pursued to investigate the environments requiring hardening of our weapons and to assess the steps taken to provide such hardening.

Senator **Levin**. While the new Administration's DOE budget revisions increase resources to some of the department's nuclear weapons activities, such as testing, the revisions severely cut the resources of the ICF program (25 percent overall; 30 percent in operating funds).

Considering the emphasis the new Administration is planning on national security, and DOE's contributions to it through its nuclear weapons programs, this slashing of the ICF budget which underwrites significant contributions to this weapons research seems to be a contradictory action.

In addition, no one has been able to satisfactorily explain why this reduction was made to the ICF program, and why the reduction was of this magnitude. Can you provide us with such an explanation, as well as try to clear up this contradiction? Are there problems with the ICF program of which Congress is unaware?

Secretary **Edwards**. The reduction was taken primarily because of an administration decision to focus on an R&D deliverable from current facilities and facilities under construction. This R&D doesn't presently envisage the construction of large laser facilities. The reduction also reflects the best prioritization of funding between inertial fusion and other DOE defense programs within our budgetary constraints.

Senator **Levin**. Mr. Edwards, you express concern that we have allowed our nuclear weapons research base to erode during the last 10 years, especially in the people area. I understand that for at least the past eight years, the ICF program has stimulated and revitalized major parts of DOE's nuclear weapons programs by attracting to this federal research many new, talented scientists with new ideas.

Don't you think that this drastic reduction in ICF funding will be a signal to those people that the ICF program is being sentenced to a slow death? Why do you think that these bright people will not leave the weapons lab, and that the bright scientists coming out of the universities these days will not be attracted to work at the weapons labs because of the signal and reality of this extreme ICF budget reduction? Won't this budget cause more of this erosion in the nuclear weapons industry you decry?

Secretary Edwards. The ICF program with its twin goals of military and civilian applications has appeared exciting and attracted many bright young scientists dedicated to proving inertial fusion feasibility. A significant budget cut will cause a reduction in force in the inertial fusion area both in the weapons laboratories, where the major part of inertial fusion work is concentrated; and in industrial, non-profit, and university contractors, all of whom have had important long-term commitments to the program. It is quite possible that some of these institutions and scientists will be forced to reexamine their dedication to the intertial fusion effort, but we all recognize that some budget cuts are necessary in order to implement the President's economic policy.

PROPOSED BUDGET

Senator **Levin**. How many people would be laid off or transferred from the ICF program if your proposed budget reduction is not altered by Congress?

Secretary **Edwards**. Under the fiscal year 1982 proposed budget we will lose on the order of 410 highly trained and specialized personnel from the program.

Most of these personnel will be transferred to other defense activities. Every action will be taken to assure that any displaced person will be correctly placed.

Senator LEVIN. There are reports that a convenient rationale DOE is using to justify its ICF budget cut is some unspecific "lack of technical confidence" in the program. I would like to address this issue.

Is it not true that the ICF program has been reviewed by three separate and independent committees formed by DOE and that each committee concluded there are no technical reasons for curtailing the program?

Secretary EDWARDS. Senator, we are not using the rationale you refer to. If 1982 were not a tight budget year, cuts would not be proposed for a program, in which the weapons laboratory directors have expressed great continuing interest. Those gentlemen are enthusiastic about the status and prospects of the inertial fusion program. It is not unreasonable, however, to access the unfolding R. & D. results from this program before deciding whether or not a commitment should be made to large future demonstration facilities. The budget cuts reflect this new emphasis by the administration.

OUTDATED INFORMATION

Senator LEVIN. I also understand that there was testimony last week before the House Armed Services Committee by the Director of Lawrence Livermore National Laboratory, one of our three weapons laboratories, that some of the information upon which the budget reduction was based was outdated, and that instead of technical problems with the program, there had been excellent progress, especially recently in the short wavelength laser experiments.

Do you think that budget revisions of this magnitude and in such an important national security program should be based on outdated information?

Secretary EDWARDS. I certainly agree with you that we should have the most up-to-date information when reaching budget decisions. As far as I know that has been the case here. I want to stress that we have not slowed down the inertial fusion program because of technical problems. We have taken a cut in this area because we cannot make increases, or even hold the line, in every program and still come within the budgetary ceiling that is given to us as a Department. We want to be very sure that we are pursuing the most cost effective program, and not simply going along from year to year without examining where the program is headed and what we can expect to get out of it. Within the budgetary ceiling available to us, and looking at our other pressing commitments, the amount we are requesting for inertial fusion appears to be appropriate to us.

ENERGY POLICIES AND PHILOSOPHIES

Senator LEVIN. Secretary Edwards, you testified to the House Science and Technology Committee on February 24, 1981, about the new Administration's energy policies and philosophies and how they were the foundation for the budget revisions being proposed for DOE. At that time you said the administration's energy policy framework is comprised of, among other components: "refocusing the government's role in energy research and development in many areas to emphasize long-term, high risk activities."

You continued by explaining "the administration's views regarding the proper role for the federal government in energy has led to a new strategy for applying federal funds to energy research and development programs." "Briefly stated," you said: "this new strategy will require the government to focus its support on longer-term, high risk research and development which industry cannot reasonably be expected to undertake. The potentially high payoffs from this research are often so distant and risky that private investors cannot anticipate an adequate return on their investment . . . Only in areas where these market forces are not likely to bring about desirable new energy technologies and practices within a reasonable amount of time is there a potential need for federal involvement."

Mr. Edwards, are you aware of the significant potential that ICF has to provide safe, almost unlimited energy for civilian use in the 21st century? Are you aware that it has potential to provide electrical or thermal energy or produce fissile fuel for nuclear power plants?

Secretary EDWARDS. The administration is aware of the very high payoff potential of thermonuclear fusion. A total of $640 million is being requested for fiscal year 1982 including both magnetic and inertial fusion. This represents a high degree of commitment. At the same time a very high degree of technical and administrative judgment is required to manage these programs, especially in view of the long term nature of the research extending over many decades.

Senator **Levin**. Are you aware however, that the best estimates as to when we can begin to realize these civilian energy benefits of ICF are well into the 21st century?

Secretary **Edwards**. We are well aware of the long-term nature of controlled thermonuclear fusion research. It is partly for this reason that we are concentrating on the most pressing issues of the ICF program, namely the achievement of ignition as soon as possible with one of the drivers presently under construction, coupled with the application of ICF to weapons physics problems of interest to that community.

ICF PROGRAM SUPPORT

Senator **Levin**. Why isn't higher DOE funding support of ICF research and development for civilian energy purposes as well as national security purposes perfectly appropriate by your very own criteria as to where the federal government should invest its civil energy R&D resources?

Doesn't ICF match exactly your definition of a long-term, high risk civil energy field with a potentially high payoff?

Secretary **Edwards**. The ICF program may indeed be appropriately termed long-term, high risk but potentially high payoff research. As such it is suitable for federal support. Specific allocation of resources always involves a difficult balance of competing factors. In this year of budget constraints the pressing need for major increases in nuclear weapon research, development and testing has taken precedence over the immediate needs in ICF.

Senator **Levin**. Don't you think that higher funding for ICF research in DOE is justifiable for both national security and civil energy well-being in the United States?

Secretary **Edwards**. Higher funding levels would certainly increase our confidence and schedule for accomplishing program goals. However, the budgetary ceiling imposed on us, in view of the other pressing priorities within DOE, renders the amount we are requesting for intertial fusion appropriate.

PLATFORM COMMITMENTS TO ENERGY TECHNOLOGY

Senator **Levin**. The 1980 Republican platform commits the Party to "stimulating new energy technology and more efficient energy use"—yet you propose to totally eliminate the Solar Energy and Energy Conservation Bank and would decrease spending for conservation and solar energy. The Platform also says that the Party would "encourage development of a domestic gasohol industry" yet your budget proposals would rescind the $745 million previously committed to alcohol fuels and biomass programs for loan guarantees, feasibility studies, and cooperative agreements. How can this be justified in light of the commitments made in the Republican platform?

Secretary **Edwards**. The Solar Energy and Energy Conservation Bank was intended primarily to promote residential energy conservation and solar technology investments through subsidies. Subsidies for some energy technologies make sense when markets are distorted in favor of others—as was the case when oil prices were regulated. This Administration believes that substantial economic incentives now exist for such investments, through higher energy prices and existing tax credits. In addition, improving the health of the economy by reducing the Federal deficit (and thereby reducing inflation, and in turn reducing the cost of capital) will do more for conservation and solar investments than offering subsidies through the Solar Energy and Energy Conservation Bank.

In the case of gasohol, DOE is recommending that the current exemption from the Federal excise tax for gasohol, as well as existing tax credits for alcohol fuels production remain in effect. This is expected to amount to an estimated $4.3 billion between fiscal year 1981 and fiscal year 1986. The Department is proposing to rescind $745 million for loan guarantees, since the subsidies mentioned above appear to be more than adequate to encourage the construction of production capacity, and the loan guarantees would encourage marginal projects to compete for private financing which would otherwise go to more productive investments.

JUSTIFYING BUDGET CUTS

Senator **Levin**. In several cases, your budget cuts are justified with statements that higher prices will allow the market to respond and that existing tax credits—as in the case of solar energy—will suffice. Yet testimony from the Energy

Conservation Coalition states that the Solar and Conserva-Bank legislation was, "written specifically to assist those who would not be expected to benefit from the 15 percent residential conservation tax credit or the 10 percent credit for business." This is backed up by evidence from the IRS showing that 65 percent of the use of residential conservation tax credits was by taxpayers in the top 25 percent of earnings. Renters and small businesses who have cash flow problems do not have the money to pay for solar and conservation investments and wait for tax returns. What programs are you proposing to help such potential users of solar and conservation technologies?

Secretary **Edwards**. The administration has not proposed additional incentives for renters and small businesses. Individuals and businesses are currently undertaking major conservation and solar investments as a result of rising energy costs and the availability of the Federal tax credits. The administration's commitment to a realistic energy pricing policy, which decontrols oil and gas prices and allows them to reach world market levels, is expected to accelerate this trend.

The administration has proposed no change in the current energy conservation and solar tax credits. The conservation credit is expected to provide at least $739 million in support of private conservation activities during 1981 and $739 million during 1982. The Federal tax credits for solar investments are expected to reduce taxes for residential and business investors by $2.6 billion between 1981 and 1986. Renters and small businesses who want to take advantage of these credits but who may have cash flow problems could borrow in credit markets an amount equal to the anticipated tax credit to finance their investments. We believe that there is no need for the Federal government to act as a financier, displacing the lending activities of private banks.

Finally, the Energy Department's weatherization program for the poor who are unable to take advantage of tax incentives will continue, as part of the Department of Housing and Urban Development's community development block grant program. Thus, low-income weatherization programs will continue, but more in accord with local needs and priorities.

55-MPH SPEED LIMIT

Senator **Levin**. Can you provide for us how much oil and how many lives have been saved since the 55 mile-an-hour speed limit has been mandated?

Secretary **Edwards**. The 55 mph speed limit is estimated to save 160,000 barrels of petroleum per day [1] and reduce fatalities by 6,500 persons per year.[2] Since the 55 mph national speed limit was enacted (January 1974), approximately 400 million barrels of petroleum and 45,000 lives have been saved.

Senator **Levin**. The eight states that participated in the International Energy Agency Allocation Supply Test of last November reported that the sysem did not work well. They were concerned, for example, that the West Coast had a glut of oil while there were shortages on the East Coast. What plans do you have to improve the ability of the IEA program to meet the potential energy shortages?

Secretary **Edwards**. Eight states were invited by DOE to participate in the IEA's Third Allocation Systems Test (AST-3) to help identify problems in U.S. domestic energy contingency plans. This was the first time states participated in an IEA oil-sharing test. States were advised prior to the test that the primary purpose of AST-3 was to train personnel, identify problems, and test the communication system that supports oil-sharing internationally among participating countries. Due to the artificial, restrictive timetable of the exercise, the normal consultative process between the Federal and State governments was substantially constrained. Also, since the standby, Buy-Sell program was tested successfully in AST-2, it was decided not to test it fully in AST-3. Data resolution and the opportunity to simulate the reallocation of crude oil or petroleum produces among regions or states were extremely limited and therefore it was not envisioned that oil would be moved domestically to solve all the state imbalances caused by the AST-3 scenario. However, in a real crisis these imbalances would be resolved. The IEA has established an Ad Hoc Group to review its Charter to consider possible amendments to improve the IEA's ability to deal with international oil supply disruptions. An interagency group, including representatives from the Department of Energy, State, Treasury, Defense, and Justice, the Office of Management and Budget, and the National Security Council is currently reviewing subjects such as improving the IEA's data system, pricing oil transferred during an emergency, and levels and use of oil stocks.

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[1] Robert L. Mason, Russell W. Zub, Highway Fuel Economy Study, Transportation Systems Center U.S. Department of Transportation, Draft Final Report prepared for the National Highway Traffic Safety Administration, January 1981.

[2] P. Johnson, T. M. Klein, P. Levey, D. Maxwell, "The Effectiveness of the 5 mph National Speed Limit as a Life Saving Benefit," U.S. Department of Transportation, 1980.

SET-ASIDE PROGRAMS

Senator LEVIN. I would like to ask you about why the set-aside program was eliminated. The National Governors Association had asked that it be retained. The Administration has said that they prefer the market to meet allocation needs, but shouldn't we be prepared to do something . . . if the market neglects the fuel needs of hospitals or school buses? Without a set-aside program, each state is likely to declare an emergency during a severe supply shortage. Wouldn't . . . 50 different emergency systems be a greater burden on industry than a uniform system?

Secretary EDWARDS. The state set-aside program was eliminated along with the rest of the price and allocation control system, some months prior to the expiration date of statutory authority for controls. The rationale for early decontrol, that is, the demonstrated costs and inefficiencies of the regulations, applies to the state set-aside program as well as to other aspects of the price and allocation control system. While the existence of a set-aside for distribution by state authorities provides states with some degree of flexibility to ease localized supply problems, the creation of a set-aside actually increases the severity of the general supply shortfall. In a period of adequate supply, the state set-aside program is superfluous since the market system supplies consumer needs, in all regions, better than centrally-directed allocation systems. In a tight market or in a period of severe shortfall, activation of the set-aside program actually pulls more product out of normal distribution channels and worsens the shortage. That 5 percent of a state's supplies is likely to be distributed faster and more efficiently to those local areas where demand is highest by the actions of the marketplace than by state energy offices. Legitimate concerns that certain groups will be particularly hard-hit and require assistance can be addressed adequately through programs which do not interfere with the efficient distribution of energy in a shortage.

Alternative policies to allocate supplies in a disruption must be viewed in the proper perspective; any allocation program will have serious shortcomings. Past experience with disruptions, and with the effects of price and allocation regulations, has shown that the government does a poor job of allocating a shortfall. While petroleum markets are by no means perfect, they are likely to be able to respond more flexibly and function more efficiently than a central allocation authority during a shortage as well as under more normal circumstances. Analysis underway in the DOE is focused on policies to ensure that the market works as well as possible in a disruption and that consumers are protected.

JOINT ENERGY SECURITY

Senator LEVIN. Can you explain for us the function of the new joint Energy Security Project that is being established by the Departments of Energy, State and Defense?

Secretary EDWARDS. The administration is deeply concerned about this country's ability to forestall or resolve serious and prolonged oil supply interruptions affecting the United States and its allies. We are beginning a comprehensive interagency review of the problem and options to deal with it. The function of this interagency approach is to ensure that our domestic and international economic, political and defense interests are taken into account in the development of policies concerning energy security.

Senator LEVIN. Because of U.S. dependence on imported oil, the defense of the Persian Gulf has become a major concern of this committee. Every U.S. President since the 1973 oil embargo has emphasized the need to reduce this dependence. Yet, the Reagan Administration proposes cutting government support for energy conservation measures, as well as ongoing development of synfuels and alternate energy sources. Why does the Administration feel the private sector will expend the enormous resources necessary to develop alternate energy sources to the point they can replace oil?

Secretary **Edwards**. We believe that the existing structure of the market, oil prices that reflect the oil's real replacement cost, tax credits for energy investments made by individuals as well as business, and the aid available to investors in the form of financial instruments and guarantees provided by the U.S. Synthetic Fuels Corporation provide sufficient incentives to the private sector for commercializing alternate energy sources. The legitimate government role in bringing alternate energy sources on-line, we believe, is twofold: (1) to fund research and development that is too costly, too risky, or too prolonged to successfully compete for private sector resources; and (2) to help create an economic and regulatory climate conducive to the safe, environmentally sound commercialization of alternatives to imported oil.

Senator **Levin**. What kind of signal does this send about the U.S. commitment to end our dependence on foreign oil?

Secretary **Edwards**. The most important signal that the United States is committed to reducing its dependence on foreign oil is the decontrol of oil prices. This provides market incentives to increase domestic energy production and energy efficiency and ends what has been, in effect, a subsidy for the import of oil. The international response to decontrol has been uniformly positive.

Senator **Levin**. Aren't we counting on companies that thus far haven't moved fast enough in developing alternate energy sources while other governments, like those of West Germany and Japan, are moving heavily into the development of synfuels and alternate energy technologies?

Secretary **Edwards**. On the contrary, our companies are making steady progress in resolving the technical and economic uncertainties surrounding alternate energy commercialization. We expect that progress in this infant industry will continue, and we will obesrve synthetic fuels earning an increasing market share. As for the synfuels commercialization programs in West Germany and Japan, neither country approaches the level of effort underway in the United States. Based upon preliminary projections compiled by the International Energy Agency, the United States could account for as much as one-half of total IEA synfuels output by the year 2000. Japan and West Germany, by comparison, could each account for 5 to 10 percent during the same period. We will continue to examine these estimates as our policies toward synfuels activities unfold.

OIL IMPORTS FROM LIBYA

Senator **Levin**. One of the Middle Eastern nations most hostile to the United States is Libya. Libya is responsible for blatant aggression in Chad and recent press reports have documented the presence of Soviet, Cuban and East German advisors there. According to Department of Energy figures, Libya was the United States's third largest supplier of oil in 1980. Why does the United States depend so heavily on such an unstable source of oil? Does the Reagan Administration intend to do anything to lessen U.S. dependence on this particular source? If so, what?

Secretary **Edwards**. The volume and source of oil imports into the U.S. market is determined by private firms and depends primarily on the price and quality of the crude. Libyan crude is at the upper end of the OPEC price range but not greatly overpriced relative to Nigerian, Algerian or North Sea crudes. Of greater importance, however, is the fact that Libyan crude is light and has a low sulfur content—the qualities needed by the U.S. refining industry. Light Libyan oil is particularly suited for making gasoline, which is the main use of petroleum in the United States. The gasoline yield of Libyan crude after simple processing is much higher than, for example, typical heavy Venezuelan crudes. Furthermore, many U.S. refineries cannot handle crude with a high sulfur content, the so-called sour crudes. These refineries can, however, use Libyan crudes, because they have a low sulfur content and will not damage the processing units. The other major sources of light sweet crude imports are Algeria, Nigeria, and the North Sea.

The administration is taking steps to reduce dependence upon any one foreign source by increasing the production of domestic energy resources—both through providing greater market in countries and by removing unnecessary regulatory barriers. We are also working on our own and in cooperation with our allies to reduce our vulnerability to oil supply disruptions from any foreign source.

INERTIAL FUSION

Senator LEVIN. The new administration's energy policy, as I understand it, is to support long range, high risk energy supply activities—activities where industry cannot reasonably be expected to "go it alone". Isn't inertial fusion a prime example for increased support?

Secretary EDWARDS. In terms of its civilian energy potential, inertial fusion can be described as a long term, high payoff, high risk energy research activity. At the present pace commercial viability, if it materializes, would not be expected until perhaps the second decade of the next century. For this reason, coupled with the sensitivity of the weapons-related physics, it is unreasonable to expect industry to assume any substantive role in the program for some time. The inertial fusion program is thus appropriate for federal support at a level which must be a compromise between the competing needs of long range research and near-term military payoff.

Senator LEVIN. I notice that the weapons program overall is increasing, so I assume that in the National Laboratories no one will actually be riffed. Is this so, and isn't the situation much more difficult for a small organization like KMS Fusion?

Secretary EDWARDS. It is true that the weapons program budget will increase in fiscal year 1982 so that we expect most of the people will be transferred from the inertial fusion program to the weapons program. But it would be necessary to examine the skills and capabilities needed by the weapons program, before a general statement about reductions in force at the National Laboratories can be made. The budget reductions are expected to fall more or less proportionately on all program participants, so that the size of the organization should not be a factor in managing the decreased budget.

Senator LEVIN. I understand that for over eight years now the ICF program has stimulated and revitalized the nuclear weapons program by bringing in many new people and new ideas. Would you care to comment on this and on the impact that proposed cuts in the ICF budget would have on this trend?

Secretary EDWARDS. One of the byproducts of inertial fusion research is progressive refinements in weapon [deleted] technology that evolve from studying the physics of burning targets on a laboratory scale. The inertial fusion program, in focusing on similar kinds of physics problems, has brought new talent, methods, and data to the weapons community. Some of this would be diminished but we expect most of these personnel to be utilized in the expanding weapons R&D program.

Chairman TOWER. The hearing is adjourned.

[Whereupon, at 10:50 a.m. the hearing was adjourned, subject to the call of the Chair.]

FISCAL YEAR 1982 DEPARTMENT OF ENERGY AUTHORIZATION FOR NATIONAL SECURITY PROGRAMS

TUESDAY, MAY 5, 1981

U.S. SENATE,
SUBCOMMITTEE ON STRATEGIC AND
THEATER NUCLEAR FORCES,
COMMITTEE ON ARMED SERVICES,
Washington, D.C.

The subcommittee met in open session at 8:35 a.m., pursuant to notice, in room 212, Russell Senate Office Building, Senator John W. Warner (chairman) presiding.

Present: Senators Warner, Thurmond, Stennis, Jackson, and Exon.

Staff present: Paul C. Besozzi, minority counsel; Frank J. Gaffney, Alton G. Keel, Jr., Ronald F. Lehman, and James C. Smith, professional staff members; and Marie Fabrizio Dickinson, staff assistant.

Also present: Bill Furniss, assistant to Senator Quayle; Will Smith, assistant to Senator Jackson; Frank Krebs, assistant to Senator Cannon; and Greg Pallas assistant to Senator Exon.

OPENING STATEMENT BY SENATOR JOHN W. WARNER, CHAIRMAN

Senator WARNER. Good morning, ladies and gentlemen.

The full committee having disposed of the fiscal year 1982 defense procurement authorization bill, the subcommittee must now move to act on S. 846, the fiscal year 1982 Department of Energy bill for authorization of defense programs. Under the provisions of the Budget Act, the full committee should report this bill by May 15, 1981.

The bill we are considering totals over $5 billion in new authority and covers in general the nuclear weapon programs of the Energy Department.

We had an overview session with Energy Secretary Edwards and he has provided us with policy positions of the new administration. Today, I want to get into budget details.

At this point, we are in open session, but we will announce when we go into executive session, which would require a "Q" clearance to attend.

Our first witness this morning will be Adm. Hyman Rickover, Deputy Assistant Secretary for Naval Reactors, Nuclear Energy.

Admiral, I can't tell you what a personal pleasure this is for me to be chairman of a subcommittee before which you appear. I have waited 12½ years for this opportunity. I am not sure how I will restrain myself throughout this hearing this morning, but I will do my very best.

You and I have had a long, close friendship and personal relationship, beginning in 1969. I want to say on the record that your wisdom and friendship have contributed materially to whatever minor successes I may have had in this world. I thank you, sir.

You may proceed.

STATEMENT OF ADM. H. G. RICKOVER, USN, DEPUTY ASSISTANT SECRETARY FOR NAVAL REACTORS, U.S. DEPARTMENT OF ENERGY; ACCOMPANIED BY J. W. VAUGHAN, DEPUTY DIRECTOR, NAVAL REACTORS; T. L. FOSTER, DIRECTOR, FISCAL ACQUISITION AND LOGISTICS MANAGEMENT; S. HANESSIAN, PROGRAM MANAGER FOR TRIDENT AND ADVANCED SUBMARINE PROJECTS; AND J. A. PALMER, PROGRAM MANAGER FOR SURFACE AND WATER-COOLED BREEDERS

Admiral RICKOVER. Senator Warner, it is very difficult for me to express my admiration for all that you have done. As you will remember, a few months ago I told you I had contemplated running for Senator from Virginia at the time you ran, but you dissuaded me. Now I will change my tune and say when you do run, I will use my energies to help you get reelected.

Now, having said that, is there any more I need to testify on? [Laughter.]

Senator WARNER. I would much rather have the wisdom and energy of your beautiful wife and that of mine, and in that way we can succeed. If a couple of barnacles like ourselves try it, we will mess it up.

Admiral RICKOVER. That is right. Between you and me, as far as beauty is concerned, we even out.

Senator WARNER. Admiral, for this morning's session we received a very detailed statement from you, and that statement will go into the record. It provides a valuable reference and therefore I want it in the record in its entirety.

[Prepared statement of Adm. H. G. Rickover follows:]

Prepared
Statement of Admiral H. G. Rickover
Deputy Assistant Secretary
For Naval Reactors
Department of Energy
FY 1982 Authorization Hearings —

Mr. Chairman, I deeply appreciate this opportunity to state my views concerning the programs for which I am responsible as well as other issues of importance to the future of our country.

NAVAL NUCLEAR PROPULSION PROGRAM

The Naval Nuclear Propulsion Program is a joint program of the Departments of Energy and Navy. I serve both as the Deputy Assistant Secretary for Naval Reactors in the Department of Energy, and the Deputy Commander for Nuclear Propulsion in the Naval Sea Systems Command. The combination of the responsibilities of the Departments of Energy and Navy for naval nuclear propulsion under one organization eliminates duplication of programs and resources and provides close coordination of technical work.

The Department of the Navy is responsible for the military application of nuclear propulsion including constructing, operating, and maintaining nuclear powered ships, and for developing the non-reactor portions of the nuclear propulsion plants. The naval nuclear propulsion work funded by the Department of Energy provides for the research and development of nuclear reactors for warships. In this regard, Naval Reactors is responsible for reactor plant research, design, development, construction, operation, maintenance and proper control of radioactivity pertaining to naval nuclear propulsion plants and for all related reactor plant safety aspects. These responsibilities also include selection, training and qualification of personnel for operating and maintaining these plants. Within the Department of Energy (DOE), Naval Reactors is also responsible for the Water Cooled Breeder program, a civilian reactor development program.

The naval and civilian reactor development work for which I am responsible is under the cognizance of the Assistant Secretary for Nuclear Energy, who is assigned all reactor development and safety work for the DOE. The placement of Naval Reactors with other nuclear energy programs originated in the Atomic Energy Commission and is embodied in the Department of Energy Organization Act because the research and development effort performed by Naval Reactors involves areas of technology common to the other nuclear energy components in DOE. This organizational arrangement allows the most effective interchange of reactor development and safety technology to the benefit of all DOE reactor work and should be continued.

NUCLEAR POWERED WARSHIPS

In the more than a quarter century since 1953, when the NAUTILUS land prototype first operated, the number of nuclear powered warships has grown to a present total of 128, representing more than 40% of the Navy's major combatant ships. This figure includes 35 ballistic missile submarines (SSBN's), 81 attack submarines (SSN's), three aircraft carriers (CVN's), and nine cruisers (CGN's). There is also one nuclear powered deep submergence research vehicle, the NR-1. These ships have steamed a total of more than 47 million miles; yet there has never been an accident involving a Naval reactor nor has there been any release of radioactivity which has had a significant effect on the environment. In addition to the operating ships, there are also nine TRIDENT ballistic missile submarines, 23 LOS ANGELES Class high speed attack submarines, and two NIMITZ Class carriers authorized by Congress or presently under construction.

The Naval Nuclear Propulsion Program is responsible for more operating reactors than the total of all U.S. civilian nuclear power reactors.

NAVAL REACTORS DEVELOPMENT PROGRAM

The Naval Reactors Development program carries out nuclear propulsion development work essential for maintaining the security of the United States. Nuclear propulsion provides the Navy with ships having virtually unlimited high speed endurance and freedom from the logistics umbilical cord for propulsion fuel. This greatly reduces vulnerability to enemy action and allows ships to be designed with a greatly increased capability for sustained combat operations.

This program provides for the design, development, testing and evaluation of improved naval nuclear propulsion plants and reactor cores having long fuel life, high reliability, improved performance, and simplified operating and maintenance requirements. The nuclear propulsion plants and cores cover a wide range of configurations varying in size from small submarines to large surface ships.

Particular emphasis is placed on obtaining advanced long life cores for increased ship performance and availability. Extending the operating life of cores will materially benefit the Navy from the standpoint of both cost and operations. Longer nuclear core operating lives increase the percentage of time nuclear fleet units are available for operational duties. This allows greater operational flexibility and provides additional assurance of availability and endurance to fight a war. This is a most important consideration, because any future naval war will most likely have to be fought with the ships available at the start of hostilities.

An additional benefit of developing long life cores is that, as core lives increase, the number of refuelings will be reduced, thereby reducing costs, minimizing workers' radiation exposure, and minimizing the amount of radioactive waste to be stored or processed. As an example, the first core for the USS NAUTILUS propelled the submarine two years and 62,000 miles, while a modern core is good for ten to fifteen years and over 400,000 miles.

The Department of Energy budget request for the FY 1982 Naval Reactors Development program is as follows:

	Budget Authority
Operating Funds	$279.5 million
Capital Equipment Funds	28.0 million
Construction Funds	54.0 million
TOTAL NAVAL REACTORS DEVELOPMENT	$361.5 million

An unclassified description of the FY 1982 Naval Reactors Development program budget request is attached as Appendix I.

The FY 1982 budget request of $361.5 million provides for a continuation of current programs. This increase of $58 million over FY 1981 is primarily due to escalation, increased efforts in ongoing core development work, and funding of $35 million for the Modifications and Additions to Prototype Facilities construction project, which was fully authorized in FY 1981. Also included are funds for the design, long-lead procurement and site preparation leading to a subsequent appropriation request for a Materials Facility at Savannah River, South Carolina to provide a second source for the production of naval nuclear fuel. At present, a shutdown of the sole fuel supplier would quickly jeopardize the fuel supply needed to support the nuclear powered fleet. During FY 1982, work will continue on a number of developmental efforts. These efforts are directed toward specific applications or to determine the potential advantages of various technological concepts. The major efforts are:

1. An advanced design nuclear propulsion plant, which represents a major reactor plant advance, is installed and presently being tested in a prototype reactor plant. This reactor plant is for the TRIDENT strategic ballistic missile submarines.

2. A Submarine Test Core which will test significant improvements that may lead to increased core lifetimes.

3. An advanced design, higher performance reactor plant for application to future classes of attack submarines.

4. An advanced reactor concept which is potentially applicable to future submarine and surface ship designs and has the potential of permitting installation of a higher power reactor in a given hull size.

5. The D2W reactor which is installed and presently being tested in a prototype reactor plant. This reactor is expected to have increased reliability and longer life than present type cores and should provide about 15 years of ship operation before refueling.

6. The Advanced Fleet Core which will utilize new concepts in fuel element manufacture that are expected to extend

fuel element performance, thereby providing a foundation for future cores with the potential to last the design life of a ship without refueling.

7. Materials development and corrosion testing efforts aimed at extending the life of reactor plants and components beyond the original 20 year design lifetime in support of the Department of Defense's policy of extending ship lifetimes.

In conjunction with these efforts, the Naval Nuclear Propulsion Program operates and tests land-based prototype nuclear propulsion plants. Eight land-based prototype propulsion plants are now in operation which are used for research, development, test, and evaluation of reactor and propulsion plant designs, and to train and qualify Navy personnel for operating and maintaining Naval nuclear propulsion plants.

The budget request also includes funds for plant and capital equipment in support of the above programs. This includes an advanced scientific computer system which will permit increased sophistication in analysis of nuclear reactor performance. Areas where the computer will be most beneficial include nuclear and thermal/hydraulic analysis, safety analysis, and materials and structural mechanics. This system will directly support the design of longer life Naval fuel systems and cores. Also included is further funding for a project to modify and make additions to several prototype facilities to upgrade plant system capabilities and initial funding for a facility to provide a second source for Naval nuclear fuel.

THE SOVIET NAVAL THREAT

Due to the Iranian crisis and Soviet aggression in Afghanistan, the United States increased its Naval presence in the Indian Ocean. Meeting the logistics requirements of such an increased force has demonstrated the significant value in having nuclear powered ships that are not dependent on fossil fuel. The recent launches of two new large Soviet nuclear powered submarines, a new nuclear powered cruiser and the emergence of the high speed deep diving Alfa class nuclear powered submarine, should dispel any remaining doubts that the Soviets are driving for naval superiority. The large nuclear powered submarines appear to be capable of taking an arsenal of tactical and strategic weapons away from their shores and placing them under the ocean. Our attack submarines and other anti-submarine warfare platforms must be capable of combating this threat.

We are faced today with a naval threat more serious than any since World War II. I believe there is a consensus on the seriousness of this threat and of the weaknesses in our defense posture. This naval threat directly challenges the free use of the seas and thus the lifelines of the Western alliance.

Twenty-six years ago, Admiral Gorshkov, the Commander-in-Chief of the Soviet Navy took command of a navy which was little more than a defense-oriented extension of the Soviet Army.

Under him, the Soviet Navy has been transformed by building over 1800 new ships and combatant craft in 140 different classes. This is a program of naval expansion that far surpasses the peacetime efforts of any other naval power. From a defensive fleet in World War II, the Soviet Navy has evolved into a major blue-water navy that challenges the U.S. for control of the seas almost everywhere in the world. The Soviet momentum for superiority in all phases of naval warfare continues while U.S. naval plans have been far from certain and have fluctuated every year.

Over an extended period the Soviet Navy has increased in numbers of ships and in capability. For example, the number of nuclear powered submarines in the Soviet fleet has increased from 69 in 1969 to about 170 today, surpassing us in this area in 1970. During this same period, the number of Soviet major surface combatants, including aircraft carriers,has increased from 220 to 273 while our major surface combatants and aircraft carriers have fallen from 301 to 193. While the Soviet fleet has increased in size, ours has declined.

For submarines, the comparison is particularly ominous. Currently the Soviets have about 372 submarines; we have 121. They have about 170 nuclear powered submarines; we have 116. They have 202 diesel powered submarines, all built since World War II, we have 5. The following table compares the submarine fleets.

COMPARISON OF UNITED STATES AND SOVIET SUBMARINES*

April 1981

SUBMARINE TYPE	SOVIETS	U.S.
Attack		
Nuclear	55	81***
Non-nuclear	160	5
Cruise Missile		
Nuclear	45	0
Non-nuclear	25	0
Ballistic Missile		
Nuclear	70**	35
Non-nuclear	17	0
Subtotal		
Nuclear	170	116
Non-nuclear	202	5
GRAND TOTAL	372	121

* Numbers are approximate.

** Ballistic missile submarines include 29 YANKEE's, 33 DELTA's and 8 older units. Not all are capable modern launcher platforms.

***Approximately 20 units thus far are equipped with the HARPOON cruise missile which can be launched from torpedo tubes.

Soviet Ballistic Missile Submarines

In the area of strategic submarines, the Soviets have about 70 nuclear powered ballistic missile submarines, compared to our 35. Today the Soviets have 29 YANKEE Class submarines which are equivalent to our POLARIS and POSEIDON submarines, and the Soviets also have at sea 33 ships of their more modern DELTA Class ballistic missile submarines, with more under construction. These carry missiles with a 4,200 mile range. This means that from their operating areas in the Barents Sea and northern waters, they can target the entire United States, Canada, and most of Mexico.

In September 1980 the Soviets launched a new class of submarine which was constructed in a very large construction hall at the Severodvinsk shipyard in the northern USSR. This submarine represents the first ship of a new class of nuclear powered ballistic missile (SSBN) submarine, designated as the TYPHOON. Available information indicates that this new submarine is extremely large and represents a totally new Soviet design. It is estimated it may even be larger in size than the U.S. Navy's new OHIO Class SSBN (about 18,000 tons submerged displacement). It is believed that the TYPHOON will be capable of carrying at least 20 advanced design submarine-launched ballistic missiles. The DELTA submarines can today cover most targets from the relative security of their home waters -- the TYPHOON will certainly have no less capability. It is expected that the initial unit of the TYPHOON class could begin sea trials this spring.

In total, the Soviets have almost twice as many nuclear powered ballistic missile submarines as the United States, and they continue to build more. Our first TRIDENT submarine is not expected to be delivered until later this year. Even then, the building rate for TRIDENT submarines will only be about one a year.

Soviet Attack and Cruise Missile Submarines

The Soviets have a total of 285 attack and cruise missile submarines, compared to our 86. Of their total, about 100 are nuclear powered, of which about 45 carry cruise missiles in separate launchers in addition to torpedoes. The U.S. has only 81 nuclear powered attack submarines. The U.S. has only within the past few years begun introducing into the submarine fleet the HARPOON cruise missile, which can be fired from torpedo tubes. In contrast, the Soviets continue adding to and modernizing their cruise missile submarine force.

In the spring of last year the Soviets launched a new class of nuclear powered cruise missile submarine (SSGN) at the Severodvinsk shipyard in the northern USSR. It has been designated the OSCAR Class and is believed to be the first ship of a new class of nuclear powered submarines capable of launching anti-ship cruise missiles while remaining submerged. Initial information indicates that this submarine is substantially larger than earlier Soviet SSGNs, which even today are themselves still considered to be large submarines. As such, it is expected to carry a much greater number of a new type of anti-ship missile with improved capabilities over present systems.

Even though the Soviets have spent considerable effort designing new cruise missile and ballistic missile submarines, they have not reduced their effort in developing attack submarines. Presently the Soviets have 55 nuclear powered and 160 conventional attack submarines. You are all well aware that they have introduced a new ALFA class nuclear powered attack submarine which is deep running and very fast.

Soviet Submarine Construction Capability

The Soviets have the largest and most modern submarine yards in the world, having a nuclear submarine production capability of 20 ships a year working on a one-shift-per-day basis. While not fully utilizing this vast building capacity, they have since 1970 completed about 100 nuclear powered submarines. For many years they have been outbuilding us in nuclear powered submarines at an average ratio of three to one. As late as 1966, the Russians had only two new construction yards for building nuclear submarines; today they have five. To give you an idea of how large these construction facilities are, you could fit all the U.S. nuclear submarine construction facilities into just one large Soviet submarine facility. Yet, even with this far superior capacity, they have continued to expand their submarine facilities in recent years.

During the peak years of our submarine building program we were constructing nuclear submarines in seven shipyards -- five private and two Naval shipyards. The most submarines we were able to deliver to the fleet in any one year since World War II was 17 and this was 17 years ago. Thirteen of these seventeen were of the POLARIS type which had the highest national priority and unlimited funding. Over the last five years the U.S. Navy has averaged 2 submarines per year. At present, the maximum U.S. capacity to build nuclear submarines is about one fourth that of the Soviets, and our capacity could be further reduced if the current construction rate is maintained.

Large Soviet Submarine Design Effort

Of greater concern than total numbers is the emphasis the Soviets place on innovation in submarine design. Since 1970 they have introduced more new submarine designs than have ever been put to sea during a comparable peacetime period in all of naval history. During this period the Soviets have introduced at least 12 new submarine designs, or major modifications in design, besides converting older submarines to improve their capabilities. These include the TYPHOON ballistic missile submarine, the OSCAR cruise missile submarine, and the ALFA high speed attack submarine I previously mentioned. In contrast to these wide ranging developments, the U.S. has introduced only three new submarine designs during this time.

Soviet Submarine Program Priority

The Soviet submarine program enjoys strong support and virtually unlimited funds. It is the centerpiece of their entire naval effort and all other aspects are really secondary to this submarine effort. They have a centrally controlled program that provides continuity and uniform direction over many years. They have built a huge array of facilities, tried out many designs and learned from their mistakes. They continue new developments in parallel with producing their best available current models in a well-structured, consistent way. They have trained a large number of technical people committed to submarine work, some of whom now have decades of experience. That experience is obvious in the improvements we see in the new ships they are building. They are exploring many areas of submarine research and development.

We, on the other hand, have a fluctuating, uncertain approach to our submarine efforts. Today we are struggling to keep even a modest technical and industrial base for submarine work. As discussed in more detail later, we also have submarine research and development programs that are subject to change due to budget changes and transient management.

The Soviets have made their nuclear submarine program of highest national priority because they know it has the greatest potential for defeating the United States in any war that is not quickly decided by strategic nuclear weapons. The capabilities of modern nuclear submarines are awesome; no one has yet experienced what they can do in an unrestricted war at sea. Soviet attack and cruise missile nuclear submarines would be able to devastate our ocean commerce unless we are prepared to counter them and carry the war to their own waters.

Soviet Surface Warships

The trends in the Soviet surface navy are also of great concern. Today, the Soviets have more major surface combatants than the U.S. and are introducing new ships at an alarming rate. Their ships are modern and well-armed. Many carry surface-to-surface missiles, which are just being introduced into the U.S. fleet. They presently have 273 principal surface combatants and aircraft carriers compared to our 193. The Soviets have recently shown that they have a place in their navy for aircraft carriers. The recent operation of the KIEV and MINSK along with construction of a sister ship shows that the Soviets are prepared to deploy a naval aviation capability which has been a major strength of the U.S. Navy.

Four New Soviet Cruiser Classes, One Nuclear Powered

The Soviets continue to build modern cruisers armed with their most modern electronic and weaponry systems. They presently have four new classes of cruisers under construction. The first of their new class of nuclear powered cruisers, the KIROV, was completed in 1980. At about 25,000 tons, it is the world's largest nuclear powered cruiser. Our largest nuclear powered cruiser, the 20-year-old USS LONG BEACH, displaces 17,000 tons. The new Soviet cruiser is larger than the nuclear powered strike cruiser once proposed by the U.S. Navy. The Soviets obviously recognize the importance of having nuclear powered cruisers that can operate at long distances from their home bases without fossil fuel support.

The table that follows compares the Soviet and U.S. surface fleets.

COMPARISON OF UNITED STATES AND SOVIET
ACTIVE SURFACE SHIPS

April 1981

	SOVIETS	U.S.
Aircraft Carriers	2	12
Surface Combat Type		
Aviation Cruiser	2	0
Cruisers	35	27
Destroyers	66	80
Frigates	168	74
SUBTOTAL	273	193
Other Type Ships/Craft		
Patrol Combatant Type	120	3
Coastal Patrol Craft	420	0
Amphibious Ships	86	59
Mine Warfare Ships/Craft	400	3
Auxiliaries	1132	78
SUBTOTAL	2158	143
TOTAL	2431	336

NUCLEAR POWERED SUBMARINES

Nuclear Powered Ballistic Missile Submarines

One of the essential elements of the defense of the United States is our fleet of nuclear powered submarines. The POLARIS, POSEIDON, and TRIDENT nuclear powered ballistic missile submarines provide the most effective means of keeping nuclear war from our shores.

Presently there are 35 POLARIS and POSEIDON ballistic missile submarines in operation. Nine TRIDENT submarines have been authorized and the shipbuilding program proposed by the Department of Defense for Fiscal Year 1982 includes funds for construction of the tenth TRIDENT submarine.

The TRIDENT submarines will have increased survivability compared to existing POLARIS and POSEIDON submarines because they are being built with the latest technology. They will be more difficult to detect than existing POLARIS and POSEIDON submarines because the TRIDENT submarines will be quieter and their longer range missiles will give the submarine 10 to 20 times more ocean area in which to hide. Our existing POLARIS and POSEIDON submarines are noisy compared to our current standards. They were all built with the technology of the 1950's. Quieter submarines are necessary to decrease the probability of detection and to ensure the survivability of our seaborne strategic deterrent.

The POLARIS and POSEIDON submarines are wearing out and an orderly construction program must continue to provide replacement. Unless this is done, we will be confronted with block obsolescence. Our current force of ballistic missile submarines was commissioned during the seven-year period from 1959 to 1967. These ships have been operated under hard conditions with two crews, to allow them to be on station the maximum possible period of time. If we extend the operating life of these ships, recognition must be given to the possibility of more out-of-service time for maintenance and repair.

The longer range of the TRIDENT missiles will permit basing our ballistic missile submarines in the United States -- no foreign basing will be required. This will eliminate the vulnerability of our ballistic missile submarine force to international political action that could deny us the use of foreign bases. This is extremely important because we are always in danger of losing our foreign bases.

I believe there is general acceptance that the TRIDENT program is vital to our national survival. I recommend the Congress continue to support it.

Nuclear Powered Attack Submarines

While the importance of strategic nuclear powered submarines is widely recognized, this has not generally been the case for our nuclear powered attack submarines. These ships provide one of the most potent and versatile means we have of keeping open the sea lanes essential to our nation and our allies;

defending the most valuable surface ship task groups from enemy submarines; providing a valuable anti-submarine warfare capability; and carrying the fight to the shores of any potential adversary.

Nuclear powered attack submarines have historically not received consistent support within the Defense Department commensurate with their importance. From the inception of the nuclear powered submarine program three decades ago, it was the Congress that took the initiative to spur our nuclear attack submarine program. In fact, Congress appropriated the funds for the power plants for the first two nuclear submarines, the NAUTILUS and the SEAWOLF, in the Atomic Energy Commission budget because the Department of Defense did not recognize the importance of nuclear propulsion. Just over a decade ago, the Defense Department planned to stop building any more nuclear submarines, at the very time the Soviets were about to pass us in numbers of nuclear submarines, which they did in 1970. Congress rejected the DOD plan and insisted on getting started on a higher speed nuclear powered attack submarine, the SSN 688 LOS ANGELES Class. Almost every year since, including last year, Congress added funds for LOS ANGELES Class submarines to the budgets requested by the Department of Defense. Thirty-seven of these ships have now been authorized for construction, of which 14 are now operational. Many of the other 67 nuclear powered attack submarines currently in operation will become obsolete by the time the presently authorized LOS ANGELES Class submarines are completed. The obsolescence problem will become even greater in later years. Since 1973, the Navy has stated it has a bare minimum requirement of 90 nuclear powered attack submarines if it is to carry out its mission in wartime. However, with operations and obligations in virtually all oceans of the world, the number which would really be required to fulfill all the wartime missions is much higher. With the retirement of submarines too old for service, the Navy will fall below even the minimum required force level of 90 if a procurement rate of only one nuclear attack submarine per year is continued as was presented to Congress by the DOD last year and in the initial budget for this fiscal year.

The current force level of 81 attack submarines is nine shy of the 90 ship level and even this level has been reached only by converting three of the older POLARIS ships to serve in an attack submarine role. The number of attack submarines we should have is not for me to determine. However, the subcommittee on Seapower and Strategic and Critical Materials of the House Armed Services Committee looked into this in depth and issued a report on December 12, 1979. In that report they made the following recommendation that:

> "The rate of authorization of nuclear-powered attack submarines be increased to at least three, and preferably four, per year. The building rate should be at a level sufficient to attain and maintain a force level of no fewer than 90 of the most capable nuclear-powered attack submarines, taking into consideration the planned retire-

ment of submarines of older classes."

Congress last year authorized two FY 1981 LOS ANGELES Class attack submarines and long lead funds for an additional three of these submarines. I strongly endorse the effort being made to increase the submarine building rate to assure we achieve and maintain our minimum force levels.

Aside from the question of submarine force levels, there is the question of what attack submarine design we should build. During the past few years, former high officials in the Department of Defense gave considerable attention to the prospect of building cheaper and less capable nuclear attack submarines. Such submarines would cost less to build than the LOS ANGELES Class because they would be smaller, have less propulsion power and be slower. The studies were recently completed and again confirm that the higher speed capability of the LOS ANGELES Class is necessary to help counter the Soviet advances. The studies also show, as demonstrated in numerous previous studies, that attack submarine costs can be significantly reduced only by compromising essential ship performance capabilities.

The Chief of Naval Operations recently completed a separate thorough review of the attack submarine issue. He concluded that the Navy should continue to build and improve the LOS ANGELES Class attack submarines and discontinue design efforts on the slower less capable attack submarines. Apparently, the issue of building less capable submarines is dead for now. The LOS ANGELES Class design is the best nuclear attack submarine we can build with available technology and we should proceed with construction and improvement of this class until a more capable design is developed.

Nuclear Submarine Construction Capability

The need for adequate numbers of ballistic missile and attack submarines relates directly to the country's capability to produce them. Today the United States has only two shipyards building submarines, Electric Boat Division of General Dynamics and Tenneco's Newport News Shipbuilding Company.
During construction of earlier submarines we had as many as seven shipyards - two Naval and five private - building nuclear powered submarines. Thus over the past several years, the submarine shipbuilding industrial base has significantly shrunk in this country while, as I previously discussed, it has significantly expanded in the Soviet Union.

If we are to achieve and maintain adequate force levels of attack and ballistic missile submarines while building replacements for obsolete or worn out ships, an expansion of our present submarine industrial base will be required. A recent Navy study examined the feasibility of expanding the submarine construction base and concluded that the best way to expand this capability is to use a Naval shipyard. I agree with this conclusion and recommend that Congress support such action.

Congressional support for new construction in Navy shipyards extends back many years. In 1934 Congress passed the Vinson-

Trammel Act which declared that "The United States must build and maintain a Navy of modern underage warships, second to none, on a true and reasonable parity with rival maritime navies." One provision of this law requires that the first and each succeeding alternate warship be constructed in Naval shipyards unless the President waives this requirement in the public interest. Although Congress recognized that it would be cheaper to build ships under competitive bids at private shipyards, they believed that it was important to maintain the Naval shipyards to provide competition with the private shipyards. Congress also noted that there was a need to maintain the Naval shipyards and their workers at a high standard of readiness and efficiency for any unforeseen emergency.

In 1965 Congress, while modifying certain provisions of the Vinson-Trammel Act, reemphasized the need to retain the language of the Act requiring ship construction in Naval shipyards. This provision was not only retained but its coverage expanded to include escort vessels in addition to warships.

In 1974 the House Armed Services Committee completed an extensive study on the current status of shipbuilding and recommended that "some new naval vessel construction be assigned to the Naval shipyards because the Naval shipyards are vital to the Navy and to the overall health of the shipbuilding industry in the United States." The Committee noted that the policy of not allowing construction in the Naval shipyards "prohibits the most economical use of their facilities which at the same time fosters the undesirable concentration of new construction in just a few yards."

Notwithstanding the Congressional intent to have some ship construction assigned to Naval shipyards, the Department of Defense policy since 1967 has been to construct all Naval ships in private yards, and a Presidential determination approving such action in accordance with the law has been routinely requested by the Navy and approved. The irony of this situation is that while the Navy ignored the Congressional intent to build ships in Naval shipyards, some of the problems that Congress sought to avoid through this policy have appeared. For example, one private shipyard became overloaded with construction work and has had serious problems in building ships to contract specifications. This resulted in over a year's delay in ship deliveries. Another private shipyard has been adamant in refusing to accept Navy contract terms and conditions for new construction.

Resumption of submarine construction in Naval shipyards would not only help expand our current submarine construction capability but would provide some competition that would help alleviate the difficult business and contractual problems with the present two private yards. Even with two private yards there is very little effective competition since Electric Boat is the sole builder of TRIDENT submarines and Newport News is the sole builder of nuclear powered aircraft carriers and cruisers. With these sole source procurements the Navy is often faced with having to accept the contractor's terms, conditions and prices. Once established as a precedent, the contractor can then demand these same terms and conditions on the so-called "competitive procurements" such as those for the LOS ANGELES Class attack submarines.

Without any alternative source of supply, the Navy has found it difficult to obtain its desired contract terms and conditions, in particular those which would facilitate administration of contracts on a pay-as-you-go basis as requested by Congress. Furthermore, the private shipbuilders have been able to transfer virtually all the risk of construction to the Navy while simultaneously demanding profit levels associated with contracts of the type in which the builder assumes most of the risk. For example, there are clauses that reduce the shipbuilder's risk by causing payments, over and above the contract price, for increases in labor costs, material costs, fringe benefits, electricity and fuel oil price increases. There are other clauses that may act to reopen the contract if there are changes in laws affecting the shipbuilder, also special provisions allowing for the guaranteed recovery of certain contractor facility investment. The net effect of transferring almost all financial responsibility to the Navy is that private shipbuilders have little incentive to hold down costs or to properly perform the work on schedule. In the end, regardless of the contractual provisions, these private contractors will most likely submit claims against the Navy whenever any loss not specifically covered by the contract is actually incurred. For example, although the

Navy has stated that it disagrees with Electric Boat's unprecedented claim that faulty workmanship is a risk assumed by the Navy under the insurable provisions of the shipbuilding contracts, Electric Boat continues to assert this position.

Some shipbuilders have even submitted multi-million dollar claims against contracts in which, even without the claim, they would have achieved a profit.

In the past, the argument against building submarines in Navy yards has been that the cost to build ships is higher in Navy yards as compared to private yards. However, today, considering the liberal contract terms exacted by the private shipbuilders, and the continuing threat of claims for costs not previously covered by shipbuilding contracts, I no longer believe that the cost differential is meaningful. For instance, the Navy's share of the shipbuilding claims settlement in 1978 with Electric Boat was in effect a 30% increase in the Navy's price for the eighteen LOS ANGELES Class attack submarines under construction at Electric Boat. Also cost comparisons do not include the benefit of having added capability and capacity in Navy yards which would help reduce the Navy's dependence on private shipyards and allow for a more rapid increase in shipbuilding rates as needed. Moreover, by having Navy shipyard personnel skilled in shipbuilding and operating up-to-date Navy facilities, the Navy would have enhanced capability to repair damaged ships in the event of an emergency, or if the private yards are damaged. Obviously, these two yards will be prime targets for enemy attack.

Recent experience demonstrates that it is not prudent to rely on only the private yards for construction of our urgently needed submarines. In one shipyard attack submarines now being completed will be delivered as much as four years later than the original contract delivery dates. Although there are many reasons for the delays, including some for which the Navy is responsible, shipbuilder quality control problems and poor shipyard management are largely responsible. By increasing the number of yards in the submarine construction program, the risks of long delays and interruptions of major defense programs due to major quality control problems or other difficulties in one year would be reduced. Also use of a Navy shipyard for ship construction will provide Navy personnel a means for practical experience in the actual management of new Naval ship construction which will enhance their professional performance in the administration of shipbuilding programs at the Naval Sea Systems Command.

The present capacity of private shipyards for Navy work is influenced to a large extent by the amount of commercial shipbuilding undertaken by the yards. This is a factor which the Navy has no control over and which has impacted in the past and can potentially impact future Navy construction programs.

In 1979 as a result of a steelworkers strike, the Newport News shipyard reassigned available manpower from the construction of the nuclear powered aircraft carrier VINSON, to commercial construction work. Newport News claimed this could be done because the VINSON was ahead of schedule, while the potential strike impact on the commercial work could be critical. Nevertheless, Newport News requested a 50 day contract delivery extension for the VINSON due to the effect of the steelworkers strike.

In the mid-70's Newport News had insufficient manpower to build both Navy ships and commercial liquid natural gas tankers. As a result the Navy ships were delayed.

Although General Dynamics' Electric Boat Division in Groton has only Navy construction contracts, in the past it has solicited commercial work and according to press reports is considering oil rig fabrication business for its Electric Boat Division support facility at Quonset Point. In addition, in correspondence soliciting work for General Dynamics' Quincy, Massachusetts shipyard, General Dynamics noted that it could draw upon its skilled labor from Electric Boat to assist the workers at Quincy.

To summarize, the number of shipyards capable of building submarines has shrunk in the last several years from seven to two. These two private yards have experienced significant delivery delays and cost increases on Navy ship construction programs. Additional submarine building capability is needed to achieve and maintain submarine force levels and this capability can be best obtained through a Naval yard.

Use of a Navy yard for submarine construction - in addition to expanding the U.S. submarine construction capability - would:

1. Provide an alternative so that private shipyards are not always in the position where, because they are essentially sole source, they can dictate the terms and conditions under which Navy warships are built.

2. Allow the U.S. to develop in-house submarine construction expertise to enhance its capability to oversee private shipyard programs.

3. Provide a basis of comparison to determine reasonableness of private yard costs and thus help hold down the threat of private shipyard claims.

4. Enhance capability to respond to ship repair emergencies.

SHIP PROCUREMENT PROBLEMS

In 1978 Congress allowed the Navy to settle over $2 billion in contract claims from three shipbuilders. Congress made it clear it was to be a one time settlement and the Navy and shipbuilders were to ensure future contracts were to be kept current so the Navy would not again be faced with large claims years after the fact.

Electric Boat has now advised it will be submitting claims on its contracts for TRIDENT and SSN 688 Class submarines. I expect the total amount of the claims will be large. The Navy estimates that

TRIDENT ships will be late an average of 28 months from original contract delivery dates and the remaining SSN 688 Class ships will be an average of 39 months late.

Most of the production delays at Electric Boat result from breakdowns in the shipyard's quality control system. Nonetheless Electric Boat has advised it will be submitting claims to try to recover from the Navy the costs of these problems under the current insurance provisions of the contracts. Electric Boat has even raised the prospect of trying to recover, through insurance claims, the $359 million loss the company agreed to absorb in the 1978 P.L. 85-804 claims settlement.

As regards future contracts, the Navy has not yet been able to award the four FY 80/81 SSN 688 Class submarines authorized and appropriated by Congress.

In the shipbuilding business, competitive bidding is not working to save the Government money the way it is supposed to. Electric Boat has incurred costs of about $50 million per ship more than the costs incurred by Newport News for the first five SSN 688 Class ships delivered by each shipyard. Projections for ships yet to be delivered show Electric Boat continues to be less efficient. Nonetheless, Electric Boat has received contracts for 20 SSN submarines while Newport News received contracts for 13.

Fixed price contracts are supposed to give shipbuilders a financial incentive to perform efficiently. Instead they are providing incentives to submit claims. It is becoming far easier for a contractor to get contract prices increased through changes and claims than it is for him to improve operations and reduce the cost of ship construction.

If we cannot enforce shipbuilding contracts, we might as well give up on the idea of financial incentives and simply pay contractors a management fee for operating the shipyards. In addition, the Navy needs some alternatives in attack submarine construction. As previously mentioned, reintroducing ship construction work at Naval shipyards would be helpful. Mare Island is the best choice for attack submarine work. Hopefully arrangements can be made to assign Fiscal Year 1982 ships to that yard.

The new administration will be facing these problems as it tries to expand the Navy's shipbuilding program. I believe drastic action will be required to solve these problems.

SUBMARINE RESEARCH AND DEVELOPMENT TECHNICAL PROBLEMS REMAIN UNSOLVED

The Navy should be focusing more attention on submarine research and development aimed at improving our attack submarine capabilities. I have on numerous occasions pointed out the inadequate effort and sporadic overall technical direction the Navy has been applying to improving submarine performance outside the reactor plant area. We should be doing all we can in practical areas such as submarine hydrodynamics, propeller design and shock protection in order to make our nuclear submarines faster, quieter and more resistant to battle damage. Instead, we dabble for years with uncoordinated and underfunded efforts. The following examples illustrate problems I am concerned about.

The Navy has known for over ten years that there is potential for reduction of submarine hydrodynamic drag, and hence increased speed, by improved design of the hull and appendages. Despite my repeated urging, beginning in 1971, research and development efforts on appendages did not get started until 1977 and a year later efforts were started on overall submarine hydrodynamic drag. These programs were to last seven years; however, because of the Navy's overall lack of commitment to hard-headed practical development in submarines, the Navy has reduced funding for these programs. After three years of work on these programs they will each take at least a year longer to complete due to funding cuts. If we had started this work when I pointed out the clear-cut need in 1971, by now we would already have many of the improvements in the fleet. Instead, we may have difficulty incorporating the resulting design improvements in the next class of attack submarines.

An analogous situation exists with the submarine shock protection program. A major effort to analyse and then correct any existing deficiencies was started in 1978. With the funding agreed to within the Navy at that time it was to take nine years to do the necessary testing and design work. Since then, this shock development work has received less than one-third of the funding required to do the work identified at the beginning of the program. The shock program will now stretch well into the 1990's. Our nuclear submarines have never had to fight in a war. We cannot dismiss a technical area like shock resistance on the basis of past successful operation of our submarines. All the sophisticated weapons systems in the world will be just so much ballast if the submarine is incapacitated due to shock damage inflicted by a near-miss from an exploding torpedo or mine which the ship should have been able to survive.

The propellers being provided for our latest attack submarine are another case in point. The new program for development of improved propellers got started last year. Already, the funding for 1982 and later has been reduced, which will delay the test program a year. Therefore we will have to wait an additional year for any potential improvements to submarine propellers in the fleet that might come out of this work.

Submarine fire protection is another example of too little commitment in the Navy to working on practical submarine development. This program is developing improved fire fighting methods for use in submarines and qualifying fire resistant materials for submarine construction. We have had serious fires in submarines in overhaul or during new construction in port. Given the state of our present fire fighting technology, these same fires could have resulted in loss of lives and would certainly have been even more serious if they had occurred in the confined atmosphere of a submarine at sea. I understand the submarine fire protection program is being funded at about two-thirds of what is needed. This is delaying completion of promising fire-fighting techniques by one to two years and slowing development of alternative, fire-resistant materials even more.

I urge you to carefully review these areas for increased funding when you consider next year's budget.

NUCLEAR POWERED SURFACE WARSHIPS

Over the years I have testified before Congress on many occasions about the advantages of nuclear propulsion in surface warships. Just as has often been the case with nuclear submarines, the decision makers in the Defense Department have frequently opposed building nuclear powered surface ships. It has been largely through the actions of Congress that five nuclear powered aircraft carriers and nine nuclear powered cruisers have been authorized to be built. All of these ships but the two aircraft carriers, CVN 70 and 71, are now operational in the fleet. The value of these ships, which is a direct result of their essentially unlimited high speed endurance and corresponding freedom from propulsion fuel logistic support, has been repeatedly demonstrated in everyday fleet operations, most recently in meeting the demands for extended Indian Ocean deployments half-way around the world. The wisdom of Congress in authorizing these ships has been proven at sea where our naval commanders must contend with the realities of combat-type conditions in a hostile environment.

Future construction plans for nuclear powered surface ships are not clear. As has been the case for the past three years, the original FY 1982 Defense Department shipbuilding program budget request did not include any nuclear powered surface warships. That program is now under review by the new Administration. The new Secretary of the Navy has stated that our Navy needs to be strengthened. He has advocated building up to a 600 ship fleet, including at least 15 aircraft carrier battle groups, to enable the Navy to meet its many commitments with assurance. Such a plan will necessitate a ship construction program which is considerably accelerated over that which has been proposed in recent years.

It is not for me to say how many of each kind of ship the Navy needs. However, should Congress authorize construction of aircraft carriers and their escorts, these ships should be given the advantages of nuclear propulsion.

An examination of the relative strengths of the Soviet Navy and the United States Navy quickly reveals that the only category of combatant ship in which the United States is clearly superior in numbers and individual ship combat capability is the aircraft carrier. The aircraft carrier battle group is the principal striking arm of our Navy for a nonnuclear war. Aircraft carrier battle groups provide our only means of projecting tactical air power beyond the range of provisioned and protected land bases. With the decline in the number of overseas air bases available to us, these are the forces we must turn to in time of need, as in the recent Middle East situation, which resulted in a U.S. Navy buildup to two aircraft carrier battle groups and their supporting ships in the Indian Ocean and Arabian Sea areas.

Aircraft carrier battle groups are our first line naval strike forces which would fight in the areas of highest threat. Considering the difficulties of providing logistic support in high threat areas, it is essential that the first line warships that make up our aircraft carrier battle groups be given the mobility and flexibility that only nuclear propulsion can provide. The United States has given up any possibility of matching the Soviet Navy in numbers of ships; therefore, our only hope to be able to carry out our naval mission in the areas of highest threat is to build the best first line warships we know how; this includes the use of nuclear propulsion.

Comparisons of Nuclear and Conventional Carrier Battle Groups

The initial procurement cost of nuclear powered surface warships is greater than for conventional ships. I don't know why anyone would expect to get the tremendous increase in military capabilities provided by nuclear propulsion without having to pay something for it. However, cost studies performed by the Navy over the years have shown that the overall lifetime cost of an all-nuclear carrier battle group is about the same as that of an all-conventional carrier battle group with similar weapons and sensors.

In comparing an all-nuclear carrier battle group to a conventional carrier battle group it should be recognized that the entire conventional force would be dependent on a vulnerable source of propulsion fuel. With four conventional escorts in the battle group, about 10 percent of the time one of the escorts would be off station for refueling by the carrier, or for refueling from an oiler if one accompanies the force. During refueling, the whole conventional force becomes more vulnerable due to restrictions on course and speed.

An all-nuclear carrier battle group is independent of the need to resupply ship propulsion fuel. When forming a carrier battle group, substitution of a nuclear carrier for a conventional carrier doubles the range of the battle group. When half of the escorts with the nuclear carrier are nuclear powered, the range of the battle group is doubled again. When all the escorts with the nuclear carrier are nuclear powered, the range of the battle group is essentially unlimited. It is important to note that unless the nuclear carrier is accompanied by nuclear escorts, the benefits of nuclear propulsion in the carrier will be diminished because the carrier is restricted by the propulsion constraints of the oil-fired escorts.

Elimination of the requirement for propulsion fuel in the all-nuclear carrier battle group also permits increased capacity by the nuclear carrier for aviation fuel and ordnance. For example, a NIMITZ Class nuclear carrier carries 50 percent more ammunition and almost twice as much aviation fuel as a KENNEDY Class conventional carrier. This increased capacity results in greater capability for sustained combat without replenishment. The all-nuclear carrier battle group does not have to replenish until its larger capacity of aviation fuel and ordnance has been expended; whereas, the conventional carrier battle group continues to consume propulsion fuel and must replenish every few days, even if its smaller capacity of ordnance and aviation fuel has not been consumed. In a real combat situation, a sophisticated enemy would make a determined effort with nuclear submarines and other forces to interrupt our supply lines and sink our replenishment ships. Under such circumstances, the ability of nuclear warships to retire at high speed to replenish in areas of lower threat and then return to the strike area at high speed, without concern for conserving propulsion fuel, could mean the difference between victory and defeat in the strike area.

Propulsion Fuel Supply Vulnerability

The need for a reliable worldwide fuel distribution system is the Achilles heel of our oil-fired Navy. The concern for assuring foreign oil supplies to support operations in the Mediterranean Sea and the Indian Ocean during crises in recent years amply shows this vulnerability.

During World War II, lack of oil was instrumental in the defeat of Japan. The Strategic Bombing Survey conducted after the war in a report entitled "Oil in Japan's War,", concluded:

> "In every phase of the war, oil determined Japan's strategy and governed the tactical operations of its Navy and Air Forces. The collapse of the Japanese war effort was the consequence of their inability to maintain their supply routes to the Southern Zone."
>
> "The effect of oil shortage on Japanese Naval strategy became devastatingly apparent in the campaign for the Marianas and the Philippines. Japanese Fleet units had to be dispersed between the Japanese Inland Sea and Singapore, owing to limited fueling facilities, and failure to achieve satisfactory coordination between the fleets contributed substantially to the Japanese defeat. Fuel shortage in the Home Islands deprived the Japanese naval forces fighting off the Philippines of the services of at least three battleships, which together with several aircraft carriers, were taken out of service and assigned to duties as port and anti-aircraft vessels because they consumed too much oil."

Nuclear Fuel Provides 15 Years of Operation

With existing designs of naval nuclear propulsion plants for aircraft carriers and cruisers, it is possible to provide enough energy for 15 years of naval ship operation without the need to refuel. In contrast, oil-fired naval ships must be refueled every few days. The initial nuclear fuel for a

NIMITZ Class aircraft carrier contains the energy equivalent of 11 million barrels of fuel oil, or enough oil to fill a train of railway tank cars stretching from Washington to Boston. At the current price being paid by the Navy for marine diesel fuel of $51.12 per barrel, it would cost over $550 million just to buy 11 million barrels of oil without considering the cost to store or deliver it.

Similarly, the initial nuclear fuel installed in a new nuclear powered cruiser would contain the energy equivalent of 3 million barrels of fuel oil which would cost over $150 million, not including storage and delivery costs.

All-Nuclear Battle Group More Effective

The justification for providing nuclear propulsion for major combatants in order to attain great improvements in their military capabilities has been documented in detail through analysis, the military judgement of senior naval commanders, and experience in the Fleet. Following his deployment in the Indian Ocean last year, the Commanding Officer of the USS NIMITZ (CVN 68), reported to the Chief of Naval Operations that:

> "The demonstrated ability of the nuclear powered battle group to shift from one theater of operations to another at high speed multiplies the effectiveness of each ship, giving the National Command Authority a flexibility comparable to a greater number of conventional ships."

The NIMITZ Commanding Officer is referring to the dramatic real life demonstration of all-nuclear battle group capability in January 1980, when, in response to the Soviet invasion of Afghanistan, the battle group comprised of the nuclear aircraft carrier NIMITZ and the nuclear cruisers CALIFORNIA and TEXAS completed an 11,500 mile transit from the Mediterranean Sea around Africa to the Indian Ocean in 19 days and 8 hours at an average speed of 25 knots. If this battle group had not been nuclear powered, support ships would have been required to accompany the battle group or to have been prepositioned along the transit route to provide replenishment of fuel - estimated over seven million gallons of oil for the NIMITZ alone. Either method of providing propulsion fuel would have slowed the battle group speed of advance and delayed arrival on station.

Demonstrated Value of Nuclear Power

Each nuclear powered ship added to the fleet makes a unit available to the Fleet Commander for assignment to independent operations where logistic support may be non-existent or difficult to provide. Examples are quarantines, shows of force, rescues, protection of minesweeping operations, prevention of aerial minelaying, and submarine trailing and holddown operations.

Commanding Officers of the nuclear powered cruisers recently operating in the Indian Ocean have written to me describing everyday examples of independent missions assigned them where the advantages of nuclear propulsion were vividly demonstrated. The nuclear cruisers' increased tactical flexibility afforded by freedom from propulsion fuel concerns and greater on-station time resulting from the inherent high speed endurance of the nuclear propulsion plants enabled successful completion of these assigned tasks in the difficult logistic environment of Indian Ocean operations.

In April 1980, the nuclear carrier DWIGHT D. EISENHOWER accompanied by the nuclear cruisers SOUTH CAROLINA and VIRGINIA left Norfolk, Virginia, for transit to the Indian Ocean to relieve the NIMITZ battle group. The EISENHOWER battle group arrived in 21 days, fully combat ready, and, like the NIMITZ battle group four months before, without having or requiring underway refueling enroute. In comparison, the oil-fired battle group consisting of the aircraft carrier INDEPENDENCE, the cruiser YARNELL and the destroyer CHARLES F. ADAMS left Norfolk in November 1980 in company with an oiler to relieve the EISENHOWER battle group in the Indian Ocean. The INDEPENDENCE battle group arrived 29 days later, 8 days longer than it took the EISENHOWER all-nuclear battle group to arrive there, having required refueling enroute and on arrival. The speed of the oil-fired battle group was restricted both to conserve propulsion fuel and because of the speed capability of the accompanying oiler. Though it was not essential in this instance, a delay in arriving on-station caused by such restrictions could be decisive in a crisis or battle situation.

Need for Nuclear Powered AEGIS Cruisers

Navy witnesses have testified for the past several years that the AEGIS air defense system is needed to protect our surface ships against the projected Soviet air threat in the 1980's. AEGIS ships are needed in the areas of highest threat, the same areas where our nuclear carrier battle groups will be most needed, and where the military advantages of nuclear propulsion may be essential to their mission. These ships would be key elements in providing sophisticated air defense against enemy missiles for our aircraft carrier strike forces. Yet to date, only the oil-fired gas-turbine-powered CG 47 Class AEGIS cruisers have been authorized to be built. The issue is whether nuclear powered AEGIS ships are needed to counter the projected Soviet threat.

No Nuclear Powered Cruisers Authorized Since Fiscal Year 1975

Of the nine nuclear powered guided-missile cruisers in the Fleet, none has the AEGIS air defense weapons system installed. The last of these nuclear powered cruisers authorized was the ARKANSAS, CGN 41, in the Fiscal Year 1975 shipbuilding program. The ARKANSAS, which is the fourth ship of the latest design VIRGINIA Class of nuclear powered guided-missile cruisers, completed construction and joined the fleet last year.

In acting on the Fiscal Year 1976 Department of Defense budget request, the Congress cancelled the fifth ship of the VIRGINIA Class, the CGN 42, on the basis that it should be built with the AEGIS air defense weapons system. In Fiscal

Year 1978, Congress appropriated advance procurement funds for the AEGIS-equipped CGN 42, on the basis of Department of Defense assurance that the ship would be requested for authorization in Fiscal Year 1979. Subsequent Department of Defense five year shipbuilding programs slipped the planned authorization of CGN 42 from 1979 to 1980, then to 1983. Finally, two years ago, the CGN 42 was deleted completely.

In a joint letter to the President in June 1980, the Chairman and the ranking minority member of the House Armed Services Seapower Subcommittee urged the administration to support a renewed effort to obtain without delay nuclear powered major surface combatants for the Navy. The letter specifically recommended obtaining a nuclear powered cruiser with AEGIS capability, noting the irony that while a nuclear powered cruiser has been added to the Soviet fleet, the United States has abandoned such efforts.

Responding on behalf of the President, in August 1980, the former Secretary of the Navy acknowledged that nuclear propulsion has more than demonstrated its advantages and importance. But he also reiterated the past Department of Defense position against nuclear propulsion by stating that the high initial procurement cost of nuclear ships, finite budget constraints, and the need for greater numbers of ships, have dictated that conventionally powered major combatants, such as the CG 47 Class AEGIS gas-turbine-powered cruisers, be requested in the shipbuilding program. The Secretary summarized that, "if resources were less constrained, the mission capabilities of nuclear powered major combatants would argue most powerfully for their procurement." This is a political statement made by a supposedly responsible official. "Whose bread I eat, his song I sing."

The CG 47 Class AEGIS cruisers presently being built may prove to be capable ships, but they lack the mobility, flexibility, and independence of nuclear propulsion. For example, it is highly unlikely that oilers can survive in areas where the threat is great enough to require first line naval strike forces. When a nonnuclear AEGIS ship runs low on fuel and the combat situation precludes refueling from the carrier, the nonnuclear AEGIS ship will have to retreat to an area of lower threat to meet an oiler, losing the AEGIS system's protection for the battle group just when it is most needed.

The only AEGIS ships in the FY 1982 Defense Department budget request are oil-fired CG 47 Class cruisers. Our fifth nuclear powered aircraft carrier, CVN 71, will be in service in 1988; yet none of these carriers will ever have the benefit of nuclear powered AEGIS-equipped escorts unless the current trend of authorizing only the CG 47 Class ships is modified. Recent Navy studies have included reinstatement of a construction program for nuclear powered AEGIS cruisers, but it remains to be seen whether such a program becomes reality. Until then, each year that authorization of nuclear powered AEGIS escorts is deferred is one more year that all of our nuclear carrier battle groups will be restricted by the propulsion fuel constraints of oil-fired AEGIS escorts.

The cost of AEGIS ships, regardless of their means of propulsion, dictates that only a limited number will be built. Therefore, we should build the most capable AEGIS ships we know how to build. Prompt establishment of a nuclear powered AEGIS cruiser construction program is essential if our nuclear carrier battle groups are to provide the full military effectiveness of which they are capable while having the necessary protection of the AEGIS air defense system.

Congress Must Decide

The decisions made by the Congress on the naval shipbuilding program will determine the effectiveness of the U.S. Navy nearly a decade from now. The alternatives presented for revitalizing the Navy and strengthening the Nation's defense will require careful consideration and demand difficult decisions.

The wisdom and foresight of Congress made nuclear propulsion in naval warships a reality in our first two nuclear submarines, NAUTILUS and SEAWOLF. The Joint Committee on Atomic Energy authorized the Atomic Energy Commission to fund and procure the nuclear propulsion plants for these two ships because the Defense Department was not capable of envisioning the worth of nuclear propulsion.

Congress has repeatedly had the foresight to invest in nuclear powered submarine and surface warships. In the 1962 shipbuilding program, it was Congress that substituted the nuclear cruiser TRUXTUN for a comparably-armed conventionally powered ship.

Furthermore, two years ago Congress authorized the fifth nuclear powered aircraft carrier, CVN 71, in lieu of the smaller, conventionally powered aircraft carrier recommended by the Department of Defense.

As I have said, I do not claim to know how many aircraft carriers or AEGIS ships the Navy needs to properly provide for the Nation's defense. The responsibility for determining these requirements rests with others. But it is my firm conviction that the aircraft carriers we do build, and the AEGIS escorts which accompany them, should be nuclear powered.

NAVAL ACADEMY AND NROTC EDUCATION AND TRAINING

No matter how well we design and build our nuclear powered ships, the Navy is still vitally dependent on having a sufficient number of capable officers and enlisted personnel to safely operate these nuclear propulsion plants. For many years I have interviewed prospective officer candidates for nuclear powered ships to evaluate their technical capabilities to determine their overall potential for the rigorous nuclear power training program. One area of continuing concern to me is the academic performance of midshipmen from the U.S. Naval Academy and from the NROTC colleges and universities which provide most of the officers for this program. The Navy is a technically oriented service and it should have officers with technical backgrounds. In most cases the more technical knowledge naval officers have, the better they can do their jobs.

To have midshipmen graduate with as strong a technical background as possible is clearly to the Navy's advantage. The first step in this process is for the midshipmen to major in a technical field such as engineering, math, physics, or chemistry. In this light the requirement that 80% of the NROTC students enroll in a technical major is a step in the right direction. In view of the Navy's needs, if there is to be movement in any direction from this requirement it should be towards requiring more technical graduates. However, many so-called educators would either have the NROTC units and Naval Academy produce fewer technical students or would reduce the rigor of the curricula to include more non-technical courses. We must be very wary of moves to make our future officers from the NROTC any less technically competent.

Likewise at the Naval Academy, greater emphasis should be placed on increasing the technical competence of the midshipmen by having them concentrate primarily on basic engineering fundamentals. Too many midshipmen are allowed and even encouraged to devote their time to courses and majors with little relevance to their future as officers in our technical Navy. Since the Navy has complete control over the Naval Academy, its academic program should be shaped to most effectively meet the Navy's needs.

I am also concerned that the Navy is not being a good steward of the nation's significant investment in the education of the NROTC and Naval Academy midshipmen. I have previously testified concerning the many distractions from the midshipmen's academic efforts at the Naval Academy. It has become obvious to me that a similar problem exists in the case of NROTC midshipmen.

Little attention is being paid to the academic effort put forth by NROTC midshipmen. At the Naval Academy, a midshipman attracts attention and counselling from supervisory personnel if he is failing. But comments by NROTC midshipmen suggest that even a failing average is not sufficient to attract attention from the NROTC unit staffs. It should not be surprising then that many NROTC midshipmen exert little more than the minimum amount of effort required to pass their courses. At some NROTC units the staff instructors appear to be more interested in pursuing their own advanced education than in monitoring and pushing the midshipmen to work up to their capabilities. NROTC midshipmen often state that they have never received any academic counselling from their superiors, even when their academic performance declined significantly.

Both the Naval Academy and NROTC units impose demands on the midshipmen which take significant amounts of time away from that available for their primary objective - education. Many of these demands are made under the guise of developing "leadership." Rather than developing leadership, however, such demands are either childish or of a make-work nature. They have the opposite effect of that desired, by fostering the attitude that studying is what is done when all other requirements have been satisfied.

I have recently addressed my concerns in regard to the NROTC Program to the Chief of Naval Operations, and outlined several changes I consider necessary. Specific recommendations which, if implemented, would assure a better return on the taxpayer's investment in the NROTC Program include:

1. Modify the rules governing the NROTC regular scholarship program to eliminate the option for a midshipman, after the Navy has provided him with two years of free education, to resign with no further obligations to the Navy. The residual obligation should be a minimum of two years of

service as an enlisted person.

2. Increase the overall NROTC obligation from four years of service after graduation to five years. This change would be consistent with Naval Academy requirements.

3. Require the NROTC units to assume specific responsibility for following the academic progress of their students and for assuring that the students spend the necessary study hours to achieve their full potential rather than just doing well enough to pass - as many of them are doing now.

The young people enrolled in the NROTC units and the Naval Academy are intelligent and have high potential. It should be the role of the staffs of the institutions involved to develop these individuals into the most competent naval officers possible. This requires emphasizing the academic endeavor that will enable the future officers to be technically prepared to do their jobs in the fleet.

ENVIRONMENT AND RADIATION

I have testified previously of the Naval Nuclear Propulsion Program's record in carefully controlling radiation exposure. In 1980, the total occupational radiation exposure to personnel operating ships and to the employees in the shipyards was about one-sixth the amount in the peak year 1966, even though the number of nuclear powered ships had nearly doubled. No civilian or military personnel in the Naval Nuclear Propulsion Program have exceeded quarterly or annual radiation exposure limits since 1967. The average annual exposure in 1980 of workers in shipyards building and maintaining nuclear powered ships was less than two-tenths of a rem. The average annual exposure of ship operators in 1980 was less than one-tenth of a rem.

Likewise, the record of the Naval Nuclear Propulsion Program in handling radioactive waste shows that the total gamma radioactivity released to all harbors in each of the last ten years has been less than two-thousandths of a curie. This is the total from our 127 operating nuclear powered ships, as well as the 14 tenders, 3 bases and 9 shipyards supporting these ships. This is not only far below standards issued by Federal Agencies, but is too small to have an effect on the environment. As an example, if one person were able to drink the entire amount of radioactivity released into any harbor in 1980, he would not exceed the annual radiation exposure permitted by the Nuclear Regulatory Commission for an individual worker.

The facts I have discussed and supporting details are contained in two Navy reports that are issued each year. The 1980 reports NT-81-1 and NT-81-2 have just been published and are attached to the statement.

These two reports provide a detailed account of the Navy's efforts in controlling radioactivity and radiation exposure. They have been prepared to convey the great effort we expend to ensure these matters are handled properly. They also provide perspective concerning the health effects of low-level occupational radiation exposure received by personnel in the Naval Nuclear Propulsion Program. In this regard, I would like to discuss the results of a recently issued study of Portsmouth Naval Shipyard workers.

As you may recall, in February 1978, Dr. Thomas Najarian, assisted by the Boston Globe, issued a sensationalized report which alleged that Portsmouth Naval Shipyard workers who were occupationally exposed to low-level radiation suffered twice the expected rate of overall cancer deaths and five times the expected rate of leukemia deaths. This report was based on an informal review of several hundred death records, without any official input. It caused a number of frightening news stories. The National Institute for Occupational Safety and Health, or NIOSH, was subsequently directed by Congress to investigate Dr. Najarian's report.

Under contract with NIOSH, Dr. Najarian repeated his study using data the Navy made available to NIOSH. In June 1979, Dr. Najarian testified before the Subcommittee on Health and Science Research of the Senate Committee on Labor and Human Resources on the results of his reanalysis based on official data. In his testimony, Dr. Najarian repudiated his earlier findings of increased overall cancer and leukemia. His third finding of increased blood cancers was separately repudiated at that time by the National Cancer Institute.

In December 1980, NIOSH issued a report on their investigation of the Portsmouth workers. Their study covered approximately 25,000 workers employed at the Shipyard between 1954 and 1978. Approximately 10,000 of these workers received low-level radiation exposure as part of their jobs. NIOSH's study was based on official Navy records of personnel radiation exposures and reviews of death certificates by specially trained investigators.

NIOSH found no excess of deaths due to leukemia or other cancers among the Shipyard workers. The NIOSH report specifically states, and I quote:

> "No relationship between exposure to radiation and mortality from any cause was observed among the Portsmouth Naval Shipyard population when compared to the United States white male population. Furthermore, no excess in leukemia mortality was observed in the radiation exposed population when compared to the non-radiation exposed employees at Portsmouth Naval Shipyard."

This official study clearly repudiates the earlier claim of Dr. Najarian and the Boston Globe of increased leukemia and cancer death rates among the Portsmouth workers. In fact, the study showed that the Shipyard workers were healthier than the average U.S. white male population. They actually experienced leukemia and cancer death rates below the national average.

The results of the NIOSH study are not surprising. According to the standard methods for estimating risk recommended by national and international organizations involved with radiological matters, one to two extra cancer deaths might be expected to occur among the 10,000 Portsmouth Naval Shipyard workers due to their occupational radiation exposure. Compare this to a typical group of 10,000 people in the United States, where approximately 1600 will die from cancer.

Furthermore, many scientists believe the true risk of cancer from radiation may be less than previously believed. For example, in August 1980, the National Academy of Sciences issued a report which estimates that risks for low-level radiation exposure are over 30 percent lower than previously estimated.

Despite the clear conclusion of the NIOSH study, the report and the press releases concerning the report were couched in a negative light. For example, Dr. Anthony Robbins, Director of NIOSH, was quoted in press releases as stating that the number of workers exposed at Portsmouth Naval Shipyard is not large enough nor has sufficient time passed since the majority of workers were exposed to draw any conclusions about safe levels of radiation exposure.

With the NIOSH study not substantiating the Najarian results, Dr. Robbins apparently decided to cast doubt on the study either because it failed to substantiate his personal opinions or because he desired to lay the groundwork for more studies. In my opinion, Dr. Robbins'comments do a great disservice to the Shipyard radiation workers and their families who have been subjected to three years of scare stories and who should be reassured regarding their health as a result of the NIOSH study.

There are also a few other critics who are trying to cast doubts on the results of the NIOSH study. Needless to say, this can only contribute to more public confusion about radiation. What needs to be understood is that if the low-level occupational radiation exposure had caused a significant effect on the health of the shipyard workers, some evidence of it would have clearly shown up in the study, which covered 10,000 workers over a period of two decades. The fact is, the study detected no evidence of any adverse health effects.

With respect to this work, a new concern has arisen. NIOSH has informed the Naval Sea Systems Command, which is responsible for all naval shipyards, that they would now like to conduct a cytogenetic study of Portsmouth Naval Shipyard workers. Such a study would be an entirely new research study and would involve drawing blood samples and other biological samples from the workers to look for small abnormalities in their chromosomes.

The Naval Sea Systems Command and the Navy's Bureau of Medicine and Surgery have reviewed the NIOSH proposal for such a study and concluded that a cytogenetic study of Portsmouth workers is unwarranted and inappropriate. Such a study is clearly beyond the scope of NIOSH's mandate to investigate the Najarian allegations. This study would be a basic research project with Portsmouth workers as the "guinea pigs" and would rekindle unnecessary fears among the shipyard workers and their families.

The Bureau of Medicine and Surgery was unable to identify any evidence that cytogenetic studies can predict radiation related health effects, such as cancer or genetic defects in offspring. On the contrary, the scientific literature on this subject indicates that any chromosome abnormalities that one may suspect are due to radiation exposure tell nothing about possible health consequences. Thus, a cytogenetic study of Portsmouth workers would tell us nothing about their health and indeed would not benefit them in any apparent way.

The Navy has fully cooperated with NIOSH during their epidemiologic study over the last three years because of the concerns raised by the Najarian study and the importance the Navy places on assuring employee health and safety. However, the study has had a significant impact on the primary mission of Portsmouth Naval Shipyard due to the large expenditure of effort by many key Shipyard people. The primary mission of the Shipyard is to support the Navy's nuclear powered submarines and not to be a target for more studies. Further impacting the work of the Shipyard to support this new NIOSH biological research project, which would provide no benefit for the health and welfare of the workers, is neither appropriate nor warranted. Thus, NIOSH has been informed that the Naval Sea Systems Command will not support this new study.

I strongly urge Congress to use its oversight function to ensure such unnecessary studies are curtailed.

APPENDIX I

FY 1982 DEPARTMENT OF ENERGY BUDGET FOR THE NAVAL REACTORS DEVELOPMENT PROGRAM

The FY 1982 Naval Reactors Development budget request is $361.5 million. The funding increase provides for inflation and increased effort in ongoing development work. Also, funding for the Modifications and Additions to Prototype Facilities project and a Materials Facility is included.

During FY 1982 development efforts will remain at a high level. Major developmental efforts include: a Submarine Test Core to test advanced materials and the potential for improved performance and increased lifetime; an Advanced Fleet Core which utilizes new concepts to extend fuel element performance resulting in a longer lifetime; a reactor and propulsion plant for installation in the OHIO Class, TRIDENT strategic ballistic missile submarines; an advanced design plant that will provide significantly higher performance than any other submarine plant now in use; improved higher power and longer life cores for application to CGN 36, 37, and 38 Class guided missile cruisers; efforts to determine the actual useful life of shipboard cores; and materials and corrosion testing aimed at extending the life of reactor plants and components beyond the original 20 year lifetime in support of the Department of Defense's policy of extending ship lifetime.

The Submarine Test Core (STC) is being developed and is intended to replace the Advanced Test Core in the S3G prototype plant. New materials will be tested to determine if they offer improved performance and increased lifetime while still meeting the stringent operating requirements of naval reactor cores.

During FY 1982 STC efforts will continue, including: performing analyses to demonstrate acceptable core performance and adequate core protection during initial operation; conducting material development; developing the process capability required for STC systems; conducting an irradiation test program; manufacturing and testing STC components; and conducting critical experiments with new STC material.

The Advanced Fleet Core (AFC) is being designed to utilize new concepts and is expected to extend performance, resulting in a significantly longer lifetime. Due to the extensive design, development, testing and manufacturing phases associated with this new core, efforts need to be initiated many years in advance of when the core will be available for shipboard use. During FY 1982 development of the AFC will continue. These efforts include: providing detailed nuclear design analysis and conducting critical experiments for the AFC prototype core; performing development work on the fabrication process; developing non-destructive testing techniques; conducting component thermal and mechanical analysis to confirm designs; initiating the fabrication of the closure head and core barrel; qualifying material to improve corrosion resistance in the Advanced Fleet Core; and conducting confirmatory irradiation tests.

The TRIDENT strategic ballistic submarine will be powered by the S8G nuclear power plant, a major reactor plant advance. During FY 1982 efforts will include: operating the S8G prototype reactor plant; performing and evaluating periodic physics tests on the prototype plant and the lead TRIDENT ship, SSBN 726; preparing final recommendations for an S8G inspection; and conducting hydraulic analyses to support prototype and ship operation testing.

Another major effort in the Naval Reactors program is designing and developing an advanced design reactor plant to provide substantially higher performance than any other submarine propulsion plant now in use or being developed. The higher speed capability will allow the Navy to further exploit a nuclear powered submarine's advantages in either an offensive or defensive role. This effort includes designing, procuring, and installing a partial prototype of the advanced core in a prototype reactor plant. Efforts in FY 1982 will include: performing periodic physics, thermal and hydraulics tests on the ASNPP partial prototype reactor and associated plant components, which will be installed in a prototype reactor in FY 1981; continuing the design and development of prototype reactor plant components in an effort to reduce circuit complexity; and completing prototype maintenance procedures and tooling.

Emphasis will continue to be placed on the design, development, test, and evaluation of the D2W reactor. This core is expected to have increased reliability and a longer life than present cores and incorporates the latest proven technological advances in nuclear system and component design. This core also has a longer life that is expected to provide about 13 years of ship operation before refueling. A D2W core is installed and being tested in a prototype reactor plant.

In FY 1982, Naval Reactors will: continue operating the long life D2W prototype core; prepare for D2W core inspection required to evaluate structural changes; continue procurement of a D2W core; and perform periodic testing of the prototype reactor to support engineering evaluation of its design and operation. Design support will be provided for the backfit of the D2W reactor in nuclear powered cruisers.

The S7G advanced reactor concept development effort consists of a reactor utilizing a new concept which is currently being tested in a prototype plant. During FY 1982, efforts will include: operating the prototype core; carrying out periodic physics engineering tests; providing physics support for S7G advanced shipboard design studies; completing manufacture of S7G replacement parts.

Materials Development provides the research and development effort required to evolve improved materials and new manufacturing processes for long life Naval nuclear cores. During FY 1982, the material effort will include: developing materials which will be able to withstand higher fuel depletions and longer life and still meet the corrosion resistance and other stringent operational requirements of Naval reactor cores; examining spent cores to obtain confirmatory information on the behavior of materials exposed to a reactor environment; and continuing efforts to determine the actual useful life of shipboard cores.

The breakdown of the FY 1982 budget request by category is:

		BA (in Millions)
Plant Development:		
Operating expenses		$ 49.0
Reactor Development:		
Operating expenses	148.0	
Capital equipment	28.0	
Construction	54.0	
Subtotal		230.0
Reactor Operation and Evaluation:		
Operating expenses		73.0
Program Direction		
Operating expenses		9.5
TOTAL		$361.5

A discussion by budget category follows.

I. PLANT DEVELOPMENT

The Plant Development effort is directed toward making significant improvements in plant realiability through development of new and improved primary and steam plant components, systems, and alternate materials and heat treatments. This effort is necessary as the long term reliability of operating plant components and systems is essential to continuity of power operations.

Component and system development work begins with reactor plant arrangement studies to determine operational requirements and proceeds through design, testing and operational support. Components and systems are sized to meet operational conditions and new materials are incorporated along with features to improve performance and meet Naval requirements. Mathematical models are then developed to assess component performance and to allow data to be obtained from simulated plant operation. Installation suitability and maintenance capabilities of the primary plant components and systems are then verified in full scale mockups. Finally, prototype components are fabricated and subjected to exhaustive testing and evaluation.

Extensive testing and analysis of candidate materials is carried out to develop possible alternate material heat treatments, new materials, and operating parameters for reactor plant applications. Materials testing is accomplished, including fundamental metallurgical development, heat treatment, corrosion and mechanical property testing and failure analysis to verify material performance characteristics prior to commitment for use in reactor plants. Also, new techniques for testing are evolved and applied to improve material performance analysis and for use in ensuring proper control of reactor plant material performance. The Plant Development work is accomplished in two ongoing areas: Materials, Chemistry and Support Development and Plant Technology. During FY 1982 effort will continue in both areas.

As part of this effort, data is obtained from operating reactor plants to determine performance and possible problem areas. This data is incorporated in the developmental process.

In FY 1982 Naval Reactors will continue efforts in this area, including: improving the function of reactor coolant purification systems; corrosion fatigue testing; continuing development, sample collection, and analysis and technical support to activities in the areas of radiological work procedures; performing analyses to support the continued construction, acceptance testing, delivery, and operation of OHIO and LOS ANGELES Class submarines; providing plant engineering support for prototype plants; completing engineering efforts for CGN 41 testing; and continuing modifications and testing of plant components.

II. REACTOR DEVELOPMENT

The Reactor Development effort is focused on developing advanced pressurized water reactors as heat sources with improved power capabilities, increased endurance, and added reliability for nuclear propulsion applications with the ultimate objective of the program being to develop cores that will last the lifetime of the ship. The power capabilities of the reactors under development must cover a wide range of configurations and ratings suitable for installation in Naval combatants which vary from small submarines to large surface ships. To attain the program's objective, the design and development of new and advanced reactors will incorporate the latest reactor concepts and technology in developing cores and associated components.

The foremost developmental needs for reactor cores of increased endurance are the fuel materials which must be capable of sustaining increased irradiation damage due to time at operating conditions. In parallel, development of control concepts capable of controlling these long life cores is necessary. The design and analysis of these advanced Naval cores is highly demanding to correctly predict long term reactivity behavior and material response in core concepts optimized to overcome the extremely hostile environment.

The developmental effort includes the fabrication of prototype cores and components for installation, operation, and testing in prototype reactor plants to determine performance capability and reliability under actual plant conditions. Sophisticated process and inspection techniques are developed and tested for application in the manufacture of advanced Naval cores. Expended cores are examined to determine long term nuclear, material and component behavior. Data obtained from these examinations is incorporated into current developmental efforts. Work to extend the existing proven pressurized water reactor technology will be conducted in several major ongoing areas: Core Examination, Materials Development, Nuclear Design and Analysis, Reactor Process Development, and Reactor Technology.

During FY 1982 work will progress in this area, including: examining test samples; improving the endurance of shipboard cores; developing final design models and procedures to allow better analysis of both current and advanced material design; investigating new fabrication techniques and advanced products for incorporation in core elements; preparing reports of tests conducted in various prototypes; manufacturing cores for testing in a prototype plant to confirm manufacturing feasibility and demonstrate the performance of new materials; completing structural analysis of Advanced Submarine Plant equipment design; and following operations and periodic testing of all eight prototype plants.

Capital Equipment

Capital Equipment funds are requested in FY 1982 to support continuing research and development activities. The only major item is a Class VI Computer for the Bettis Atomic Power Laboratory. This advanced scientific computer system, with computing capability three to five times that of the current system, will permit the solution of increasingly complex nuclear reactor problems.

Construction

Major construction funds are requested in FY 1982 for the Modifications and Additions to Prototype Facilities (MAPF). This project received full authorization in FY 1981. The MAPF project provides for modifying the engineered safety features of several prototype plants. The work primarily involves upgrading the emergency fluid and electrical supply system capabilities and includes construction of necessary support buildings at the S3G, S1C, and D1G prototype reactor plants.

Funding is also requested for the design, long-lead procurement and site preparation leading to a subsequent appropriation request for a Materials Facility at Savannah River, South Carolina. The proposed facility will provide a second source for the production of nuclear fuel used in naval nuclear propulsion reactors. The new Materials Facility will incorporate all facilities, systems and equipment necessary to convert highly-enriched uranium to naval nuclear fuel for use in fabrication of reactor cores.

General plant project funds provide for minor plant improvements, alterations, additions, and minor new construction at Naval Reactors' laboratories.

III. REACTOR OPERATION AND EVALUATION

Reactor Operation and Evaluation involves the operation of land based prototype nuclear propulsion plants and related servicing and evaluation functions. The purpose is to test complete developmental plants, including individual cores and components. The reason for this is that nuclear propulsion plants are required to operate at a high tempo under harsh conditions with minimum maintenance for many years. While tests are used as an aid to simulate and predict behavior, actual in-service operation is the only way to reliably determine performance and provide design confirmation. In order to fully test reactor components and systems, prototype plants are highly instrumented to provide test data under various operating conditions that could be encountered. Special tests are periodically conducted and the results are compared with predictions to improve the precision of reactor design methods.

Procedures and equipment are designed and developed to service reactor plants. Servicing work includes: maintenance, refuelings, disassembly, fuel exchange and reassembly operations on prototype and shipboard reactors, examination of installed reactor components and removal of reactor components for examination. Equipment and procedures developed for prototype operations are used to the maximum extent in preparing for the servicing and refueling of shipboard reactors.

During FY 1982 work efforts will include: evaluating prototype periodic testing; conducting performance and structural analysis of prototype replacement cores; performing tests using test loop models to evaluate designs and develop technology; initiating design work to install components into a prototype refueling core to demonstrate the effects of long term exposure to radiation; continuing operation of all eight prototype plants for testing and training of Naval personnel; preparing for various prototype refuelings; continuing design and development of refueling and servicing equipment for prototypes; and completing certification analysis of a power unit shipping container.

IV. PROGRAM DIRECTION

The program direction funds provide for salaries, benefits, travel and other expenses for 235 full time Federal employees at the Naval Reactors, Pittsburgh Naval Reactors and Schenectady Naval Reactors Offices in support of the Naval Reactors Development and Water Cooled Breeder programs.

Naval Reactors maintains a minimal personnel level and has been able to operate with austere staffing through careful management of personnel to meet work requirements. Existing personnel are used to the greatest extent practicable in staffing new efforts and expansions of existing programs. Improvements in work force productivity have been achieved over the years by maximum use of available staff to carry out increasing workloads. This approach has resulted in limited changes in the personnel level.

[Attachments I and II follow:]

Attachment I

Report NT-81-1
February 1981

ENVIRONMENTAL MONITORING AND DISPOSAL OF RADIOACTIVE WASTES FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES

1980

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ABSTRACT

The environmental effect of disposal of radioactive wastes originating from U. S. Naval nuclear propulsion plants and their support facilities is assessed. The total gamma radioactivity in liquids, less tritium, discharged to all ports and harbors from the more than one hundred Naval nuclear-powered ships and supporting tenders, Naval bases and shipyards was less than 0.002 curie in 1980. The total tritium released to all ports and harbors was less than one curie in 1980. This report confirms that procedures used by the Navy to control releases of radioactivity from U. S. Naval nuclear-powered ships and their support facilities are effective in protecting the environment and the health and safety of the general public.

TABLE OF CONTENTS

SUMMARY 1

RADIOACTIVE LIQUID WASTE PROCESSING AND CONTROL 3

  Policy and Procedures Minimizing Release of Radioactivity in Harbors 3
  Source of Radioactivity 3
  Radioactivity Removal From Liquid Wastes at Shore Facilities 4
  Liquid Waste Releases in Harbors 4
  Short-Lived Radionuclides 4
  Fission Product Radionuclides 6
  Tritium 6
  Carbon 14 7
  Liquid Waste Releases at Sea 7
  Loss of USS THRESHER and USS SCORPION 8

SOLID RADIOACTIVE WASTE DISPOSAL. 10

TRANSPORTATION OF RADIOACTIVE MATERIAL. 14

ENVIRONMENTAL MONITORING. 17

  Navy Environmental Monitoring Program 17

ENVIRONMENTAL PATHWAYS ANALYSIS 24

AUDITS AND REVIEWS. 29

CONCLUSIONS 31

REFERENCES 32

LIST OF TABLES

TABLE 1 RADIOACTIVE LIQUID WASTE RELEASED TO HARBORS FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES . 1

TABLE 2 TOTAL RADIOACTIVITY IN LIQUID WASTE RELEASED AT SEA ORIGINATING FROM U. S. NAVAL NUCLEAR-POWERED SHIPS 8

TABLE 3 RADIOACTIVE SOLID WASTE FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES FOR 1976 THROUGH 1980 . 11

TABLE 4 SUMMARY OF 1980 SURVEYS FOR COBALT 60 IN BOTTOM SEDIMENT OF U. S. HARBORS WHERE U. S. NAVAL NUCLEAR-POWERED SHIPS HAVE BEEN REGULARLY BASED, OVERHAULED OR BUILT 19

TABLE 5 RADIONUCLIDE RELEASES ASSUMED FOR ENVIRONMENTAL PATHWAYS ANALYSIS 26

TABLE 6 ENVIRONMENTAL EXPOSURE TIMES, CONSUMPTION AND CONCENTRATION PARAMETERS ASSUMED FOR ENVIRONMENTAL PATHWAYS ANALYSIS 27

TABLE 7 ESTIMATED MAXIMUM RADIATION EXPOSURE TO AN INDIVIDUAL FOR ASSUMED LIQUID AND AIRBORNE RADIOACTIVITY RELEASES FROM SHIPYARDS ENGAGED IN NAVAL NUCLEAR PROPULSION WORK. 28

TABLE 8 ESTIMATED TOTAL WHOLE BODY RADIATION EXPOSURE TO GENERAL PUBLIC WITHIN 50 MILES FOR ASSUMED LIQUID AND AIRBORNE RADIOACTIVITY RELEASES FROM SHIPYARDS ENGAGED IN NAVAL PROPULSION PLANT WORK 28

LIST OF FIGURES

FIGURE 1 SIMPLIFIED DIAGRAM OF WASTE PROCESSING SYSTEM 5

FIGURE 2 RADIOACTIVE SOLID WASTE DISPOSAL VOLUMES IN THE NAVAL NUCLEAR PROPULSION PROGRAM, 1961-1980 . . . 12

FIGURE 3 DREDGE FOR SAMPLING HARBOR SEDIMENT 18

FIGURE 4 GAMMA SPECTRA OF HARBOR BOTTOM SEDIMENT SAMPLES WITH LITHIUM—DRIFTED GERMANIUM DETECTOR 22

FIGURE 5 PATHWAYS FOR EXTERNAL AND INTERNAL EXPOSURE OF MAN FROM AIRBORNE AND LIQUID RELEASES OF RADIOACTIVE EFFLUENTS. 25

APPENDIX ENVIRONMENTAL MONITORING SURVEY CHARTS. 35

SUMMARY

The radioactivity in wastes discussed in this report originates in the pressurized water reactors of U. S. Naval nuclear-powered ships. As of the end of 1980, the U. S. Navy had 114 nuclear-powered submarines and twelve nuclear-powered surface ships in operation. Support facilities involved in construction, maintenance, overhaul and refueling of these nuclear propulsion plants include nine shipyards, fourteen tenders and three submarine bases. This report describes disposal of radioactive liquid wastes, transportation and disposal of solid wastes, and monitoring of the environment to determine the effect of radioactive releases, and updates reports on this subject issued by the Navy in references 1 through 15.* This report concludes that radioactivity associated with U. S. Naval nuclear-powered ships has had no significant or discernable effect on the quality of the environment. A summary of the radiological information supporting this conclusion follows:

From the start of the Naval nuclear propulsion program, the policy of the U. S. Navy has been to reduce to the minimum practicable the amounts of radioactivity released into harbors. Navy procedures to accomplish this have been reviewed with the U. S. Department of Energy, the U. S. Nuclear Regulatory Commission and the U. S. Environmental Protection Agency. The total gamma radioactivity released within twelve miles from shore from all U. S. Naval nuclear-powered ships and their support facilities in recent years is shown in Table 1; this includes all harbors both U. S. and foreign entered by these ships.

TABLE 1 RADIOACTIVE LIQUID WASTE RELEASED TO HARBORS FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES

Year	Number of Ships In Operation	Radioactivity-Curies (less tritium)
1971	100	less than 0.002
1972	104	less than 0.002
1973	107	less than 0.002
1974	111	less than 0.002
1975	113	less than 0.002
1976	115	less than 0.002
1977	120	less than 0.002
1978	124	less than 0.002
1979	126	less than 0.002
1980	126	less than 0.002

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*References are listed on page 32.

As a measure of the significance of these data, if one person were able to drink the entire amount of radioactivity discharged into any harbor in any of the last ten years, he would not exceed the annual radiation exposure permitted for an individual worker by the U. S. Nuclear Regulatory Commission.

Environmental monitoring is conducted by the U. S. Navy in U. S. and foreign harbors frequented by the U. S. Naval nuclear-powered ships. This monitoring consists of analyzing harbor water, sediment and marine life samples for radioactivity associated with Naval nuclear propulsion plants, radiation monitoring around the perimeter of support facilities and effluent monitoring. Environmental samples from each of these harbors are also checked at least annually by a U. S. Department of Energy laboratory to ensure analytical procedures are correct and standardized. The U. S. Environmental Protection Agency has conducted independent surveys in U. S. harbors; results have been consistent with Navy results. These surveys have confirmed that U. S. Naval nuclear-powered ships and support facilities have had no significant effect on the radioactivity of the marine environment.

RADIOACTIVE LIQUID WASTE PROCESSING AND CONTROL

Policy and Procedures Minimizing Release of Radioactivity in Harbors

The policy of the U. S. Navy is to reduce to the minimum practicable the amounts of radioactivity released to the environment, particularly within twelve miles from shore including into harbors. This policy is consistent with applicable recommendations issued by the Federal Radiation Council (incorporated in Environmental Protection Agency in 1970), U. S. Nuclear Regulatory Commission, National Council on Radiation Protection and Measurements, International Commission on Radiological Protection, International Atomic Energy Agency, and National Academy of Sciences—National Research Council (references 16 through 24). Keeping releases small minimizes the radioactivity available to build up in the environment or to concentrate in marine life. To implement this policy of minimizing releases, the Navy has issued standard instructions defining the radioactive waste disposal limits and procedures to be used by U. S. Naval nuclear-powered ships and their support facilities. These instructions were reviewed by the U. S. Department of Energy, the U. S. Nuclear Regulatory Commission and the U. S. Environmental Protection Agency.

Source of Radioactivity

In the shipboard reactors, pressurized water circulating through the reactor core picks up the heat of nuclear reaction. The reactor cooling water circulates through a closed piping system to heat exchangers which transfer the heat to water in a secondary steam system isolated from the primary cooling water. The steam is then used as the source of power for the propulsion plant as well as for auxiliary machinery. Releases from the shipboard reactors occur primarily when reactor coolant water expands as a result of being heated to operating temperature; this coolant passes through a purification system ion exchange resin bed prior to being transferred from the ship.

The principal source of radioactivity in liquid wastes is from trace amounts of corrosion and wear products from reactor plant metal surfaces in contact with reactor cooling water. Radionuclides with half-lives greater than one day in these corrosion and wear products include tungsten 187, chromium 51, hafnium 181, iron 59, iron 55, nickel 63, zirconium 95, tantalum 182, manganese 54, cobalt 58, and cobalt 60. The most predominant of these is cobalt 60, which has a 5.3 year half-life; cobalt 60 also has the most restrictive concentration limit in water as listed by organizations which set radiological standards in references 16, 17, and 18 for these corrosion and wear radionuclides. Therefore, radioactive waste disposal is conservatively controlled by assuming that all the long-lived radioactivity is cobalt 60.

Radioactivity Removal From Liquid Wastes at Shore Facilities

Radioactive liquid wastes at shore facilities are collected in stainless steel tanks and processed through a processing system to remove most of the radioactivity (exclusive of tritium) prior to collection in a clean tank for reuse. Even after processing to approximately 10^{-8} microcuries of gamma radioactivity per milliliter, reactor coolant is reused rather than discharged. Figure 1 shows a simplified block diagram of the waste processing system which consists of particulate filters, activated carbon bed filters, mixed hydrogen hydroxyl resin and colloid removal resin beds. This type of processing system has been developed and used successfully to produce high quality water containing very low radioactivity levels.

Liquid Waste Releases in Harbors

The total amounts of long-lived gamma radioactivity released into harbors and seas within twelve miles from shore have been less than 0.002 curie during each of the last ten years. This total is for releases from U. S. Naval nuclear-powered ships and from the supporting shipyards, tenders and submarine bases, and at operating bases and home ports in the U. S. and overseas and all other U. S. and foreign ports which were visited by Naval nuclear-powered ships. This quantity is conservatively reported as if it consisted entirely of cobalt 60, which is the predominant long-lived gamma radionuclide and also has the most stringent concentration limits.

To put this small quantity of radioactivity into perspective, it is less than the quantity of naturally occurring radioactivity (reference 25) in the volume of saline harbor water occupied by a single nuclear-powered submarine.

Although volumes are of less significance than the amounts of radioactivity released, Table 1 of earlier reports has also shown that the total volume of liquids released within twelve miles from shore has been reduced from millions of gallons per year in the 1960's to less than 25 thousand gallons per year beginning in 1973. Thus, the Navy has achieved its policy of reducing releases of radioactive liquids in harbors to the minimum practicable amounts. Therefore, volumes have been deleted from this report.

Short-Lived Radionuclides

Reactor coolant also contains short-lived radionuclides with half-lives of seconds to hours. Their highest concentrations in reactor coolant are from nitrogen 16 (7 second half-life), nitrogen 13 (10 minute half-life), fluorine 18 (1.8 hour half-life), argon 41 (1.8 hour half-life) and manganese 56 (2.6 hour half-life). Total short-lived radioactivity released in water in a year to any harbor has been less than 0.001 curie.

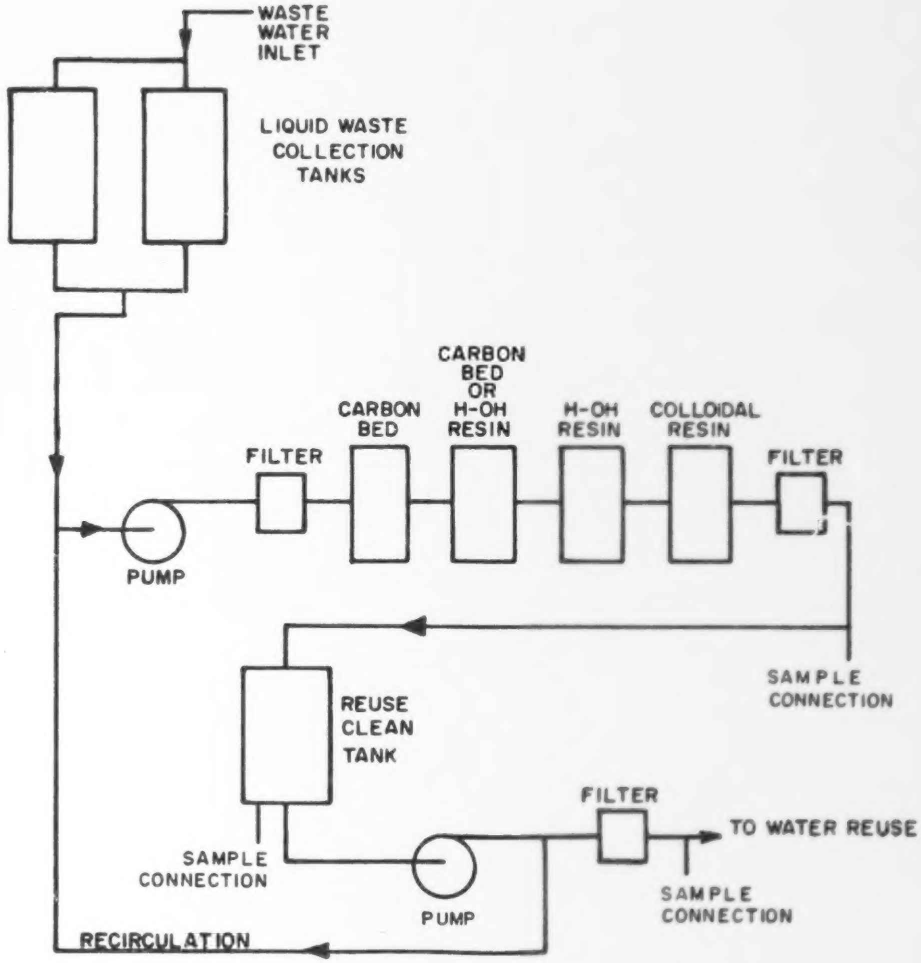
WASTE WATER INLET
LIQUID WASTE COLLECTION TANKS
FILTER
CARBON BED
CARBON BED OR H-OH RESIN
H-OH RESIN
COLLOIDAL RESIN
FILTER
PUMP
SAMPLE CONNECTION
REUSE CLEAN TANK
FILTER
TO WATER REUSE
SAMPLE CONNECTION
PUMP
SAMPLE CONNECTION
RECIRCULATION

FIGURE 1
SIMPLIFIED DIAGRAM OF WASTE PROCESSING SYSTEM

For the longest-lived of these, about one day after discharge from an operating reactor, the concentration is reduced to one thousandth of the initial concentration, and in about two days the concentration is reduced to one millionth. Therefore, since most of the water is transferred to shore facilities for processing and reuse rather than discharged, these short-lived radionuclides are not important for water disposal considerations.

Fission Product Radionuclides

Fission products produced in the reactor are retained within the fuel elements. The fission gases krypton and xenon are also retained within the fuel elements. However, trace quantities of naturally occurring uranium impurities in reactor structural materials release small amounts of fission products to reactor coolant. The concentrations of fission products and the volumes of reactor coolant released are so low, however, that the total radioactivity attributed to long-lived fission product radionuclides, strontium 90 and cesium 137, in releases from U. S. Naval nuclear-powered ships and their support facilities has been less than 0.001 curie per year for all harbors combined. Fallout of these same fission products has often been more than this in one rainfall in a single harbor.

Tritium

Small amounts of tritium are formed in reactor coolant systems as a result of neutron interaction with the approximately 0.015 percent of naturally occurring deuterium present in water, and other nuclear reactions. Although tritium has a 12 year half-life, the radiation produced is of such low energy that the radioactivity concentration guide issued by the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, the U. S. Nuclear Regulatory Commission and by other standard-setting organizations is one hundred times higher for tritium than for cobalt 60. This tritium is in the oxide form and chemically indistinguishable from water; therefore, it does not concentrate significantly in marine life or collect on sediment as do other radionuclides.

Tritium is naturally present in the environment because it is generated by cosmic radiation in the upper atmosphere. Reference 26 reports that the production rate from this source is about six million curies per year, which through rainfall causes a tritium inventory in the oceans of about one hundred million curies. Because of this naturally occurring tritium, much larger releases of tritium than are conceivable from Naval nuclear reactors would be required to make a measurable change in the background tritium concentration.

The total amount of tritium released during each of the last twelve years from all U. S. Naval nuclear-powered ships and their supporting tenders, bases and shipyards has been less than 200 curies. Most of this has been into the ocean greater than twelve miles from shore. The total tritium released from the entire nuclear Navy is less than single electrical generating nuclear power stations typically release each year (reference 27). Total tritium released into harbors within twelve miles from shore was less than one curie in 1980. Such releases are too small to increase measurably the tritium concentration in the environment. Therefore, tritium has not been combined with the data on other radionuclides in other sections of this report.

Carbon 14

Carbon 14 is also formed in small quantities in reactor coolant systems as a result of neutron interactions with nitrogen and oxygen. Carbon 14 decays with a half-life of 5730 years; however, only low energy beta radiation is emitted as a result of this decay process. As a result, the radioactivity concentration guide for carbon 14 in its chemical form in air issued by the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, the U. S. Nuclear Regulatory Commission and by other standard-setting organizations is three thousand times higher than for cobalt 60.

Carbon 14 occurs naturally in the environment. It is generated from cosmic radiation interactions with nitrogen and oxygen in the upper atmosphere and oxidized to form carbon dioxide. Carbon 14 is chemically indistinguishable from other isotopes of carbon. The carbon dioxide diffuses and convects throughout the atmosphere and enters the earth's carbon cycle. Reference 28 states that the earth's carbon 14 inventory is estimated to be about three hundred and ten million curies. The total amount of carbon 14 released during each of the last twelve years from the operation of all U. S. Naval nuclear-powered ships and their supporting tenders, bases and shipyards has been less than 100 curies, most of which is released into the atmosphere at sea beyond twelve miles from shore. The total carbon 14 radioactivity released in a year in any harbor has been less than 0.1 curie. Since the inventory of naturally occurring carbon 14 is so large, it is extremely unlikely that releases from Naval nuclear reactors could result in a measurable change in the background concentration of carbon 14. Therefore, carbon 14 has not been combined with the data on other radionuclides in other sections of this report.

Liquid Waste Releases at Sea

Radioactive liquids incidental to the operation of the nuclear propulsion plants are released at sea under strict controls. These ocean releases are consistent with recommendations the Council on Environmental Quality made in 1970 to the President in reference 29, and consistent with the Marine Protection, Research and Sanctuaries Act, reference 30. Procedures and limits for ocean releases have been consistent with recommendations made by the National Academy of Sciences—National Research Council in reference 20 and by the International Atomic Energy Agency in reference 21. These releases have contained much less radioactivity than these reports considered would be acceptable. Total long-lived radioactivity excluding tritium, released farther than twelve miles from shore by U. S. Navy nuclear-powered ships and supporting tenders is shown in Table 2 for recent years. This is the total amount released from over 100 ships at different times of the year in the open sea at long distances from land in small incremental amounts, and under rapid dispersal conditions due to wave action. The quantity of radioactivity released to the open ocean in 1980 was 0.4 curie, which is less than the naturally occurring radioactivity in a cube of sea water approximately 100 yards on a side.

TABLE 2 TOTAL RADIOACTIVITY IN LIQUID WASTE RELEASED AT SEA ORIGINATING FROM U. S. NAVAL NUCLEAR-POWERED SHIPS

	Radioactivity-Curies (less tritium)
1974	0.4
1975	0.4
1976	0.4
1977	0.4
1978	0.4
1979	0.4
1980	0.4

Loss of USS THRESHER and USS SCORPION

Two U. S. Navy nuclear-powered submarines have been lost at sea in the Atlantic Ocean. The submarine THRESHER sank 10 April 1963, 100 miles from land in water 8,500 feet deep at latitude 41°45'N and longitude 65°00'W. The submarine SCORPION sank between 21 and 27 May 1968, 400 miles southwest of the Azores in more than 10,000 feet of water. The reactors used in all U. S. Naval submarines and surface ships are designed to minimize potential hazards to the environment even under the most severe casualty conditions such as actual sinking of the ship. First, the reactor core is so designed that it is physically impossible for it to explode like a bomb. Second, the reactor fuel elements are made of materials that are extremely corrosion resistant, even in sea water. The reactor core could remain submerged in sea water for decades without releases of fission products while the radioactivity decays, since the protective cladding on the fuel elements corrodes only a few millionths of an inch per year. Thus, in the event of a serious accident where the reactor is completely submerged in sea water, the fuel elements will remain intact for an indefinite period of time, and the radioactive material contained in these fuel elements should not be released. The maximum rate of release and dispersal of the radioactivity in the ocean, even if the protective cladding on the fuel were destroyed, would be so low as to be insignificant.

Radioactive material could be released from this type of reactor only if the fuel elements were actually to melt and, in addition, the high-strength, all-welded reactor system boundary were to rupture. The reactor's many protective devices and inherent self-regulating features are designed to prevent any melting of the fuel elements. Flooding of a reactor with sea water furnishes additional cooling for the fuel elements and so provides added protection against the release of radioactive fission products.

Radiation measurements, water samples, bottom sediment samples and debris collected from the area where THRESHER sank were analyzed for radioactivity shortly after the sinking and again in 1965 by various laboratories with highly sensitive equipment. Similarly, sea water and bottom sediment samples taken near SCORPION's hull were analyzed for radioactivity. None of these samples showed radioactivity above naturally occurring background levels, and none showed evidence of radioactivity released from either THRESHER or SCORPION.

In 1977, followup samples of water, sediment, marine life and debris were collected from the immediate THRESHER debris areas. In 1979, followup samples of water, sediment, marine life and debris were collected from the immediate SCORPION debris areas. None of these samples showed any evidence of release of radioactivity from the reactor fuel elements in either THRESHER or SCORPION. However, cobalt 60 released from both THRESHER and SCORPION coolant systems was detectable at low levels in sediment samples from localized areas which were not sampled during the original surveys. The cobalt 60 radioactivity in these sediment samples was small compared to naturally occurring radioactivity. Cobalt 60 was not detectable in the samples of water, marine life or debris. Thus, the THRESHER and SCORPION have not had a significant effect on the radioactivity in the environment.

SOLID RADIOACTIVE WASTE DISPOSAL

During maintenance and overhaul operations, solid low-level radioactive wastes consisting of contaminated rags, plastic bags, paper, filters, ion exchange resin and scrap materials are collected by nuclear-powered ships and their support facilities. These low level radioactive materials from nuclear-powered ships are required to be strictly controlled to prevent loss. These controls include Naval accountability procedures which require serialized tagging and marking and signatures by radiologically trained personnel.

Solid radioactive waste materials are packaged in strong tight containers, shielded as necessary and shipped to burial sites licensed by the U. S. Nuclear Regulatory Commission or a State under agreement with the U. S. Nuclear Regulatory Commission. Solid radioactive materials from Naval nuclear-powered ships have not been dumped at sea since 1970 when the Navy issued procedures prohibiting sea disposal of solid radioactive materials. Shipyards and other shore facilities are not permitted to dispose of radioactive solid wastes by burial on their own sites.

Table 3 summarizes total radioactivity and volumes of radioactive solid waste disposal for the last five years. Table 3 includes all waste generated by U. S. Naval nuclear-powered ships and the listed support facilities since all radioactive solid waste generated by U. S. nuclear-powered ships is transferred to the listed facilities. The quantity of solid radioactive waste in any one year from a particular facility depends on the amount and type of support work performed that year. Table 3 does not include expended fuel or radioactive material associated with expended fuel since expended fuel is shipped from the refueling shipyard by the Department of Energy to its facilities in Idaho for processing in the same manner as other expended nuclear fuel.

Figure 2 shows that in the last nine years the total annual volume of solid low-level radioactive waste has been reduced by a factor of five despite increasing numbers of ships. Most of the volumes are generated during maintenance and overhaul operations in shipyards. This reduction has been accomplished simultaneously with reduction in personnel radiation exposure, as described in reference 31. This reduction has been accomplished by several techniques including a total containment concept for radiological work which minimizes the spread of radioactivity to non-radioactive materials, use of preplanning and mockups to minimize rework, reusing rather than disposing of tools and equipment, segregation of radioactive materials from other materials, use of liquid waste processing procedures which minimize depletion of processing media, and use of compaction equipment and efficient packaging to fully use space in disposal containers. Challenging goals are set by each shipyard to ensure continuing management attention to minimizing generation of waste in radiological work.

TABLE 3 RADIOACTIVE SOLID WASTE FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES FOR 1976 THROUGH 1980.

Facility	1976 Thousand Cubic Feet	1976 Curies	1977 Thousand Cubic Feet	1977 Curies	1978 Thousand Cubic Feet	1978 Curies	1979 Thousand Cubic Feet	1979 Curies	1980 Thousand Cubic Feet	1980 Curies
Portsmouth, New Hampshire Naval Shipyard	6	7	9	6	6	2	3	3	2	3
Groton, New London, Conn. Electric Boat Division., Tender at State Pier, & Sub Base	7	4	8	14	3	<1	4	<1	3	<1
Newport News, Virginia Newport News Shipbuilding	2	5	2	5	3	15	2	4	1	1
Norfolk, Virginia Naval Shipyard and Tenders	11	5	6	1	4	2	2	5	2	4
Charleston, South Carolina Naval Shipyard and Tenders	4	20	7	13	7	17	3	5	3	3
Pascagoula, Mississippi Ingalls Shipbuilding Div.	3	1	3	10	2	1	1	<1	1	<1
San Diego, California Tenders	1	<1	1	4	1	<1	1	<1	1	<1
Vallejo, California Mare Island Naval Shipyard	8	10	7	27	11	18	2	22	6	36
Bremerton, Washington Puget Sound Naval Shipyard	8	34	6	10	7	5	3	3	1	21
Pearl Harbor, Hawaii Naval Shipyard & Sub Base	3	6	4	1	4	12	2	2	2	18
TOTAL	53	92	53	91	48	72	23	44	22	86

NOT[illegible]

(1) This table includes all radioactive waste from tenders and nuclear-powered ships. This radioactivity is primarily cobalt 60. This radioactive waste is shipped to burial facilities licensed by the U. S. Nuclear Regulatory Commission or State.

(2) Volumes less than 500 cubic feet are reported <1 thousand and less than 0.5 curie is reported <1.

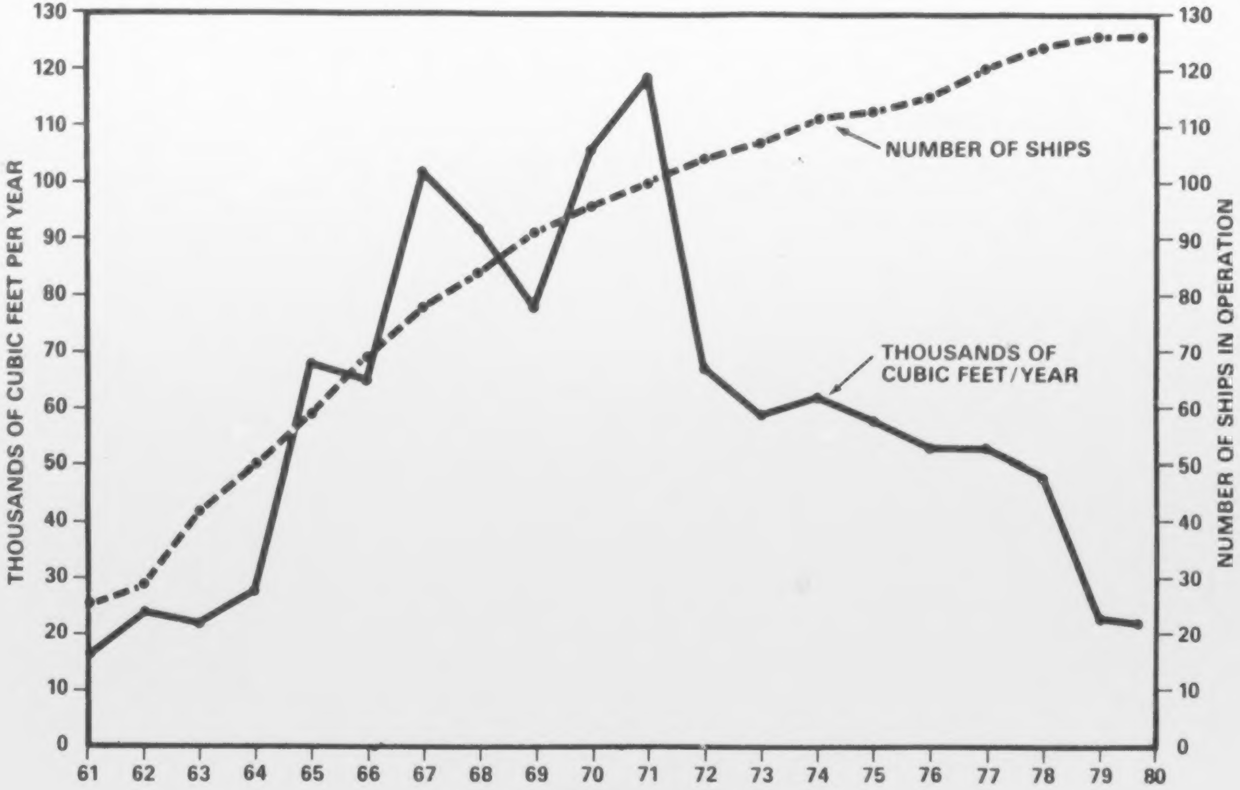

FIGURE 2
RADIOACTIVE SOLID WASTE DISPOSAL VOLUMES IN THE NAVAL NUCLEAR PROPULSION PROGRAM, 1961-1980

The annual volume for the entire Naval nuclear propulsion program could be contained in a cube measuring ten yards on a side. The total annual volumes of solid radioactive waste from the Naval nuclear propulsion program listed in Table 3 are less than some individual electrical generating nuclear power stations generate annually (reference 27). The total annual volumes are also less than 2 percent of the solid radioactive waste generated annually by all nuclear electric power reactors (reference 32) and less than 1 percent of the total volumes of radioactive solid waste buried in all U. S. commercial burial grounds each year (reference 32).

TRANSPORTATION OF RADIOACTIVE MATERIAL

Shipments of radioactive materials in the Naval nuclear propulsion program are required to be made in accordance with regulations of the U. S. Department of Transporation, U. S. Department of Energy, and U. S. Nuclear Regulatory Commission. The purpose of these regulations is to ensure that shipments of radioactive material are adequately controlled to protect the environment and the health and safety of the general public. These regulations are applicable to all radioactive material shipments including waste. The shipments discussed herein cover areas in addition to waste for completeness.

The above regulations provide requirements for the container design, certification, and identification as applicable for the specific quantity, type and form of radioactivity being shipped. Naval shipping container design requirements invoke shielding and integrity specifications and meet all regulatory requirements. They provide for testing of container designs, training and qualification of workers who construct containers, and quality control inspections during fabrication to ensure the containers will meet their design requirements.

In addition to imposing requirements of Federal transportation regulations, the Navy has issued standard instructions to further control shipments of radioactivity associated with U. S. Naval nuclear propulsion plants. These standard instructions result in a quality assurance program which includes inspections and assessments by independent organizations and senior management. Organizations making shipments are required to prepare local procedures which require use of compliance checklists and management review to ensure compliance with applicable Department of Transportation, Navy, and burial ground requirements. Only specially trained, designated people, knowledgeable in shipping regulations, are permitted to authorize shipments of radioactive material.

Protective transportation service such as signature security service or sealed shipping vehicles are required for these shipments to ensure point-to-point control and traceability of each shipment from shipper to receiver. A readily accessible log of all shipments in transit is maintained to enable prompt identification and provide the basis for advice on the nature of the shipment. Return receipts are required to be made in writing by receivers to ensure that radioactive material has not been lost in shipment. Receipt inspection of containers of radioactive material and accompanying documents are required promptly after receipt to monitor compliance. Even minor discrepancies from detailed shipping regulations are required to be reported to the shipper so that correction can be made in future shipments. This is done to ensure compliance with shipping regulations.

Radioactive materials shipped in the Naval nuclear propulsion program include anticontamination clothing for laundry, small sealed sources used for calibrating radiation monitoring instruments, tools and equipment used for radioactive work, low-level radioactive waste, radioactive components and new and spent nuclear fuel. A total of approximately 1000 shipments are made annually by Naval nuclear-powered ships and their support facilities, which is a small part of the approximately two million shipments of radioactive materials made annually in the United States (Reference 33).

Nearly all radioactive shipments in the Naval nuclear propulsion program contain only low-level radioactivity classified under Department of Transportation regulations as low specific activity or limited quantity shipments. The predominant radionuclide associated with these shipments is cobalt 60 in the form of insoluble metallic oxide corrosion products attached to surfaces of materials inside shipping containers. Most low-level shipments are made by truck. Air transport is used no more than a few times per year for the Naval nuclear propulsion program. These air shipments involve only very low-level radioactivity and are not shipped on passenger planes.

Nearly one-quarter of the low-level radioactivity shipments are minute quantities in sealed instrument calibration check sources. These sources contain insignificant quantities of radioactivity which are comparable to the radioactivity in typical ionization type smoke detectors. Approximately 65 percent of the shipments are anticontamination clothing, equipment and tools. The anticontamination laundry involves shipments of special outer clothing potentially contaminated with low-levels of radioactivity while worn in controlled work areas. This laundry is shipped by Nuclear Regulatory Commission licensed contractors to their facilities for cleaning. On the average, one shipment of low-level radioactive waste per three months is made from each facility listed in Table 3.

The remaining few shipments are new and spent nuclear fuel and radioactive components associated with spent nuclear fuel and are shipped by the U. S. Department of Energy. Such shipments are made infrequently since U. S. Naval nuclear-powered ships need refueling infrequently. Spent nuclear fuel shipments are made to Department of Energy facilities for disposition. Measures are carried out to assist in safeguarding these shipments and assuring they reach their destination. Each spent fuel shipment is escorted by U. S. Government representatives and each shipping container is specifically designed to withstand extreme accident impacts, fire, or water immersion, and to prevent release of the material to the environment in the event of an accident. The cargo in the nuclear fuel and radioactive component shipments is non-explosive and non-flammable and, in addition, the radioactive material in the radioactive components is in an insoluble form that should not be dispersed even in the event of an accident.

Estimates of radiation exposure to transportation crews and the general public from shipments of radioactive materials in the Naval nuclear propulsion program have been made in a manner consistent with that employed by the U. S. Nuclear Regulatory Commission in reference 33. Based on comparisons of the types and numbers of radioactive shipments made, the total annual radiation exposure to all transportation crews for all shipments is estimated to be less than 3 man-rem. If one person were to receive all this exposure, he would not exceed the radiation exposure permitted for an individual worker by the U. S. Nuclear Regulatory Commission. The total estimated radiation exposure accumulated by the public along transportation routes is not more than a few times higher than the exposure to transportation workers. The maximum exposure to any individual member of the public would be far less than received from natural radiation.

Shipments of radioactive materials associated with Naval nuclear propulsion plants have not resulted in any measurable release of radioactivity to the environment. There have never been any significant accidents involving release of radioactive material during shipment since the Naval nuclear propulsion program began. In general, the few accidents that have occurred involved incidents such as broken truck axles or slight external damage to a shipping container with no release of radioactivity. In one incident a train collision resulted in minor denting of a new fuel shipping container with no loss of integrity of the container, no damage to the fuel and no release of radioactivity. In the only two instances that involved loss of contents, one quart containers holding samples were broken open in shipment. In one case this occurred when a cargo aircraft crashed. The other container was lost from a commercial ship. Both containers were recovered and there was no measurable radioactivity released since the original contents were less than one millionth of a curie, too small to be measurable in the environment.

The requirements of the Naval nuclear propulsion program specify that the carriers for all radioactive material shipments shall have accident plans which identify the actions to be taken in the event the transportation vehicle is involved in an accident. These plans provide for notification of civil authorities and the originating facility. The U. S. Navy would communicate with and cooperate fully with State radiological officials in the event of occurrences involving shipment of radioactive materials.

ENVIRONMENTAL MONITORING

To provide additional assurance that procedures used by the U. S. Navy to control radioactivity are adequate to protect the environment, the Navy conducts environmental monitoring in harbors frequented by its nuclear-powered ships. Environmental monitoring surveys for radioactivity are periodically performed in harbors where U. S. Naval nuclear-powered ships are built or overhauled and where these ships have home ports or operating bases. Samples from each harbor monitored are also checked at least annually by a U. S. Department of Energy laboratory to ensure analytical procedures are correct and standardized. The Department of Energy laboratory results have been consistent with shipyard and operating base results.

Navy Environmental Monitoring Program

The current Navy environmental monitoring program consists of analyzing samples of harbor water and sediment, supplemented by shoreline surveys, posted dosimeters and effluent monitoring. Sampling harbor water and sediment each quarter year is emphasized since these materials would be the most likely affected by releases of radioactivity. Marine life samples have also been collected from some harbors.

Five water samples are taken in each harbor once each quarter year in areas where nuclear-powered ships berth and from upstream and downstream locations. These samples are analyzed for gross gamma radioactivity and for cobalt 60 content. A solid state lithium-drifted germanium detector with a multichannel analyzer is used to measure gross gamma radioactivity in an energy range from 0.1 MeV to 2.1 MeV expressed in terms of cobalt 60 equivalent and to analyze the resulting gamma data for the presence of cobalt 60. Procedures for analysis will detect cobalt 60 if its concentration exceeds the U. S. Environmental Protection Agency drinking water limit of reference 24. No cobalt 60 has been detected in any of the water samples from all harbors monitored.

A radiological laboratory of the Environmental Protection Agency has analyzed samples from harbors to identify radionuclides present in sediment. These analyses showed cobalt 60 was the predominant radionuclide added to sediment from Naval nuclear reactor operations. Therefore, Navy monitoring procedures require collecting in each harbor approximately 20 to 120 sediment samples once each quarter year for cobalt 60 and gross gamma analyses. Locations and numbers of sediment samples for a particular harbor depend on the size of the harbor and the number and separation of locations where nuclear-powered ships berth. Sampling points are selected to form a pattern around ship berthing locations and to provide points in areas away from these berthing locations. The sampling locations are selected individually for each harbor considering characteristics of the harbor. Sediment samples are collected using the dredge shown in Figure 3. The dredge samples a surface area of 36 square inches and has been modified to collect only the top one-half to one inch of sediment. The top layer was selected because it should be more mobile and more accessible to marine life than deeper layers. After the dredge is lowered to the harbor bottom, the messenger weight is lowered on the support line from the surface and causes the spring-loaded jaws on the dredge to close and trap the sediment. The samples are placed directly into a one quart Marinelli container for analysis. Each sediment sample is analyzed for gamma radioactivity in the container in which it is collected using the lithium-drifted germanium detector with a multichannel analyzer. The sediment samples are not dried prior to analysis but excess water is drained off. Gross gamma radioactivity in an energy range from 0.1 MeV to 2.1 MeV is expressed in terms of equivalent cobalt 60 and the resulting gamma data is analyzed for the presence of cobalt 60 radioactivity. Results of the sediment samples from harbors monitored by the Navy in the U. S. and possessions for 1980 are summarized in Table 4.

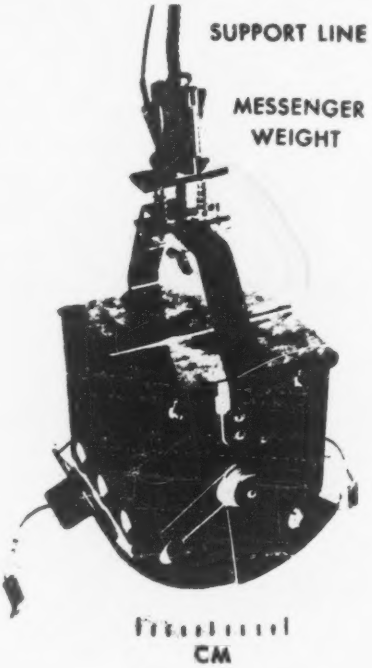

FIGURE 3

DREDGE FOR SAMPLING HARBOR SEDIMENT

TABLE 4 SUMMARY OF 1980 SURVEYS FOR COBALT 60 IN BOTTOM SEDIMENT OF U. S. HARBORS WHERE U. S. NAVAL NUCLEAR-POWERED SHIPS HAVE BEEN REGULARLY BASED, OVERHAULED OR BUILT

	Number of Samples with Cobalt 60			Total Bottom Area with Cobalt 60 over $3 \times 10^{-6}\mu Ci/gm$** (Square Kilometers)	Estimated Total*** Cobalt 60 in Top Layer of Sediment (Curies)
	less than $3 \times 10^{-6}\mu Ci/gm$*	3 to 30x $10^{-6}\mu Ci/gm$	Greater than 30x $10^{-6}\mu Ci/gm$		
Portsmouth, New Hampshire Naval Shipyard	176	0	0	0	ND
Groton, New London, Conn. Electric Boat Division, State Pier and Submarine Base	537	3	0	0.01	0.01
Newport News, Virginia Newport News Shipbuilding	151	0	0	0	ND
Norfolk, Virginia Naval Shipyard and Base	256	0	0	0	ND
Charleston, South Carolina Naval Shipyard and Bases	205	0	0	0	ND
St. Marys, Georgia	92	0	0	0	ND
Pascagoula, Mississippi Ingalls Shipbuilding Division	80	0	0	0	ND
San Diego, California Navy Piers	256	0	0	0	ND
Long Beach, California Naval Shipyard and Base	160	0	0	0	ND
Vallejo, California Mare Island Naval Shipyard	226	0	0	0	ND
Bremerton, Washington Naval Shipyard and Base	313	0	0	0	ND
Pearl Harbor, Hawaii Naval Shipyard and Sub Base	172	0	0	0	ND
Apra Harbor, Guam	128	0	0	0	ND
Port Canaveral, Florida	80	0	0	0	ND

NOTE: *Minimum detectable radioactivity is approximately 0.2 millionths of a microcurie per gram. $1\mu Ci = 1 \times 10^{-6} Ci$

**One square kilometer is approximately equal to 0.4 square mile. Areas with cobalt 60 over $3 \times 10^{-6}\mu Ci/gm$ were in immediate vicinity of piers used for berthing nuclear-powered ships.

***Where total cobalt 60 in the surface sediment layer is less than 0.01 curie, ND is reported. Samples more than one foot deep from several harbors show that total cobalt 60 present may be two to five times that measured in the surface layer.

Evaluation of the data summarized in Table 4 shows that low-level cobalt 60 radioactivity in harbor bottom sediment is detected around a few operating base and shipyard piers where nuclear-powered ship maintenance and overhauls have been conducted over a period of several years. The radioactivity detected is from operations in the early 1960's since releases such as shown earlier in Table 1 are too small to be detectable in the harbors. Cobalt 60 is not detectable above background levels in general harbor bottom areas away from these piers. Maximum total radioactivity observed in a U. S. harbor is less than 0.05 curie of cobalt 60. This radioactivity is small compared to background; based on the typical concentrations of naturally occurring radioactivity such as potassium 40, radium, uranium and thorium which are described in reference 25 for marine sediment, the natural radioactivity in the sediment of a typical harbor amounts to hundreds of curies. Comparison to previous environmental monitoring data in references 1 through 15 shows that these environmental cobalt 60 levels have been steadily decreasing.

The first data column in Table 4 includes all samples with less than 3 millionths of a microcurie of cobalt 60 per gram of sediment. Most of the sediment samples did not contain detectable cobalt 60 and are tabulated in this range. In this range cobalt 60 is comparable to the levels of naturally occurring radioactivity such as potassium, radium, uranium and thorium. Cobalt 60 in sediment in this low range may also be detectable as a result of world wide dispersion from atmospheric nuclear weapons testing.

The value of 30 millionths of a microcurie per gram was selected for the top of the second range of data in Table 4. A measure of the significance of this range is that if all a person's food were to contain cobalt 60 in this range of radioactivity throughout the year, he would not exceed radiation exposure levels permitted in references 16, 17, and 18 for members of the general public. Only three of the sediment samples are in this second range, and none of the samples exceeded this range in 1980. Data on uptake of this cobalt 60 by marine life obtained to date show that in the salt water harbor bottom environments, no significant buildup of cobalt 60 occurs in marine life. An EPA evaluation in reference 34 shows that the cobalt 60 from Naval nuclear propulsion plants is in the form of metallic corrosion product particles which do not appear to be concentrated in the food chain. Because of the nature of the radioactivity and the low concentrations noted in Table 4, extensive monitoring of radioactivity in marine life has not been necessary as part of routine environmental monitoring programs in these harbors.

In addition to Navy analysis of environmental samples, at least two sediment samples from each harbor monitored have been sent each year to a U. S. Department of Energy laboratory, as a check of Navy results. This Department of Energy laboratory provides a further check on the quality of environmental sample analyses by participating in the quality control programs sponsored by the Department of Energy and the Environmental Protection Agency.

The check samples were analyzed for gamma radionuclides in a manner similar to Navy procedures but with greater sensitivity. Figure 4 depicts the gamma spectra for two such samples. Both spectra show the presence of abundant naturally occurring radionuclides which contribute to measured radioactivity even if cobalt 60 were not present. The upper spectrum is for a sample to which cobalt 60 has been added to a concentration of approximately 3 millionths of a microcurie per gram and shows easily recognizable energy peaks due to the presence of this small concentration of cobalt 60. The lower spectrum depicts the appearance of most of the sediment samples in the first column in Table 4.

In addition to the extensive quarterly monitoring of harbor water and sediment, selected samples of marine life such as mollusks, crustaceans and marine plants have been collected in 1980 from most harbors monitored. Marine life samples are also analyzed using a lithium-drifted germanium detector with a multi-channel analyzer. No buildup of cobalt 60 associated with U. S. Naval nuclear-powered ships has been detected in these samples of marine life.

For comparison, references 35 and 36 contain evaluations by laboratories of the Environmental Protection Agency and of the Department of Energy of the effects on the environment from the accumulation near points of discharge of radionuclides from several nuclear facilities. The referenced reports conclude for these other facilities that radioactivity levels much greater than shown in Table 4 have caused no significant radiation exposure to the general public.

In all monitored harbors, twice per year shoreline areas uncovered at low tide are surveyed for radiation levels with sensitive scintillation detectors to determine if any radioactivity from bottom sediment washed ashore. All results were the same as background radiation levels in these regions, approximately 0.01 millirem per hour. Thus, there is no evidence in these ports that these areas are being affected by nuclear-powered ship operations.

Ambient radiation levels are measured using sensitive thermoluminescent dosimeters continuously posted at locations outside the boundaries of areas where radioactive work is performed. These dosimeters are also posted at locations remote from support facilities to measure background radiation from natural radioactivity. Results of dosimeters posted at support facilities between radiologically controlled areas and the general public are compared with dosimeters posted at remote background locations up to several miles away. These results showed that radiation exposure to the general public from radioactive work on Naval nuclear propulsion plants has not increased above that received from natural background radiation.

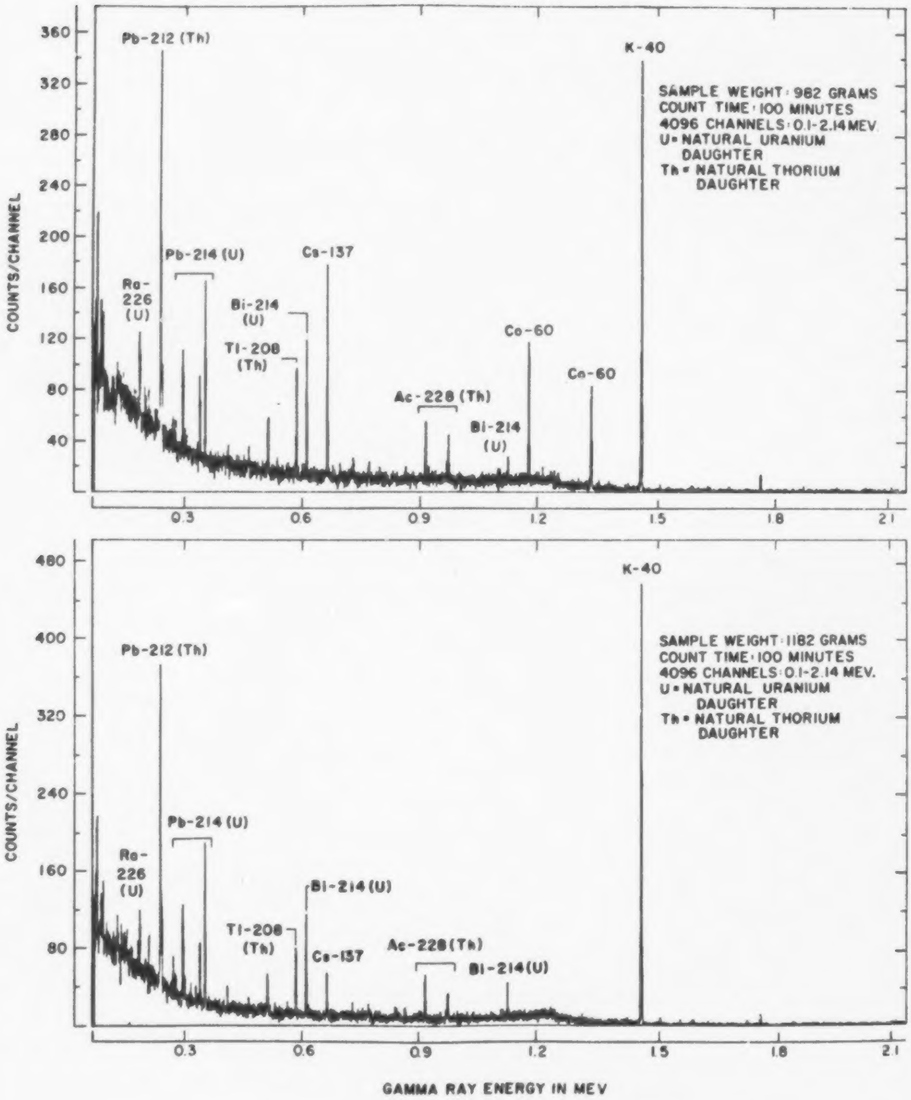

FIGURE 4 GAMMA SPECTRA OF HARBOR BOTTOM SEDIMENT SAMPLES WITH LITHIUM-DRIFTED GERMANIUM DETECTOR

Naval nuclear reactors and their support facilities are designed to ensure there are no significant discharges of radioactivity in airborne exhausts. Radiological controls are exercised in support facilities to preclude exposure to working personnel to airborne radioactivity exceeding limits for the general population specified in reference 16. These controls include a total containment concept for radioactive materials and provide a barrier to prevent significant radioactivity from becoming airborne. Further, all air exhausted from these facilities is passed through high efficiency particulate air filters and monitored during discharge. Comparision of sensitive airborne radioactivity measurements in shipyards demonstrates that air exhausted from facilities actually contained a smaller amount of radioactivity than this same air contained when it was drawn from the environment into the facilities. There were no discharges of airborne radioactivity above concentrations normally present in the atmosphere.

ENVIRONMENTAL PATHWAYS ANALYSIS

Results of monitoring of environmental samples described above have shown that environmental radioactivity levels have not been changed appreciably and therefore radiation exposure to the public from operations of nuclear-powered ships and their support facilities is too low to measure. Nevertheless, a detailed analysis has been performed to provide a quantitative estimate of the radiation exposure to which any member of the general public might be exposed as a result of radioactivity in liquid and airborne effluents.

This analysis has been performed in a conservative manner which ensures that the estimated exposure is higher than any actual exposure would be. For example, the sites chosen for analysis were shipyards since the amount of radiological work at these facilities is considerably higher than at other types of support facilities. Quantities of radioactivity from shipyard releases used in this analysis are higher than have been measured from any shipyard in the last five years. Values of environmental parameters including meteorological conditions and radionuclide concentration factors have been chosen to provide conservative results. In addition, the analysis assumes the individual receiving the maximum exposure is located right at the site boundary. Thus, the actual exposures to members of the public are expected to be lower than the results of this analysis.

The environmental pathways which were considered are depicted in Figure 5, which is based on reference 18. The hypothetical releases assumed are listed in Table 5. Table 6 shows the assumed usage parameters which are based on reference 37. Concentration factors for radionuclides in the marine environment were assumed as published in reference 38 and are also in Table 6. The pathways analysis, including meteorology, population distribution, and radiological exposure rates was performed in a manner consistent with that employed by the U. S. Nuclear Regulatory Commission in reference 37.

Results of the analysis are summarized in Tables 7 and 8. Table 7 compares the estimated maximum exposure to a member of the public with guidelines of the Nuclear Regulatory Commission, although these guidelines are not applicable to nuclear-powered ships and their support facilities. These numerical guidelines on calculated radiation exposures have been issued by the Nuclear Regulatory Commission in reference 23 for implementing the concept that radioactivity in effluents from light water nuclear electric power reactors should be limited to amounts and quantities as low as reasonably achievable. These numerical guidelines of the NRC are consistent with environmental standards for the uranium nuclear fuel cycle issued by the Environmental Protection Agency in reference 39 Table 8 presents the estimated total whole body radiation exposure to the total population within 50 miles from the assumed radioactivity releases compared with the radiation exposure received by the same population from natural background radioactivity, as reported in references 22, 28 and 40. As shown in Tables 7 and 8, conservative estimates of the exposures to members of the public from the Naval nuclear propulsion program are far less than either the EPA standards, the guidelines of the Nuclear Regulatory Commission or the exposure from natural background radioactivity.

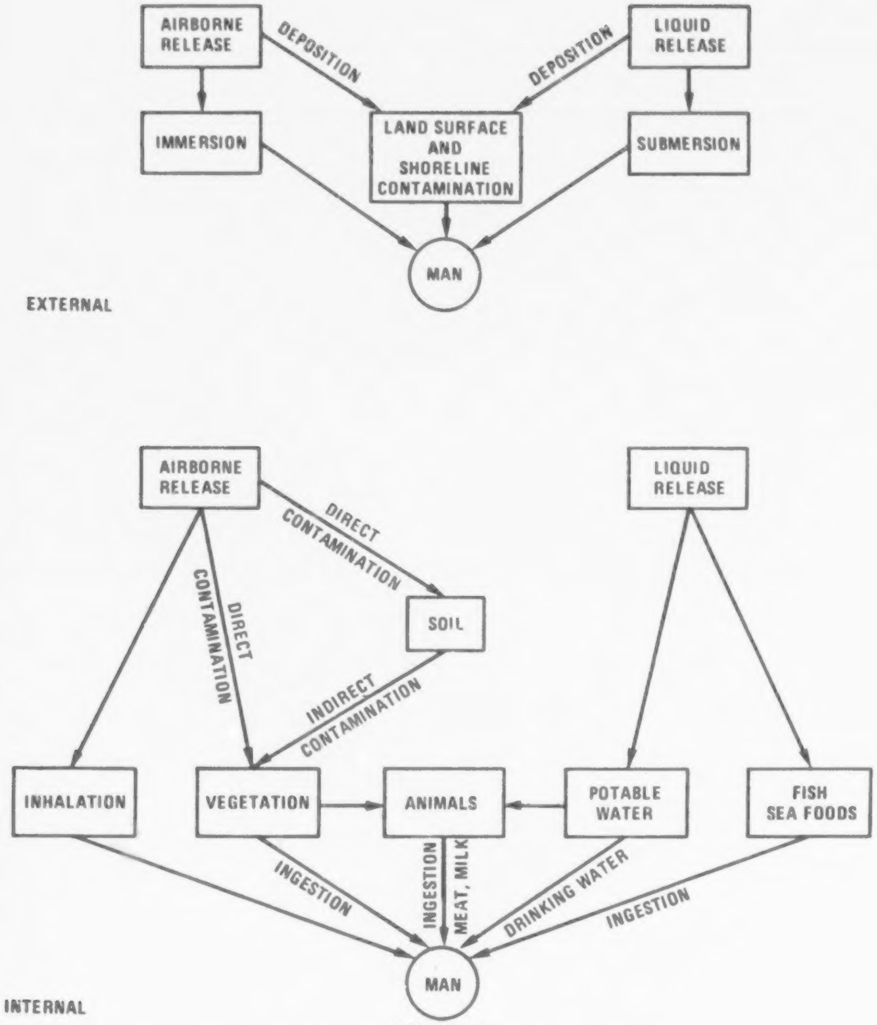
AIRBORNE RELEASE
DEPOSITION
DEPOSITION
LIQUID RELEASE
IMMERSION
LAND SURFACE AND SHORELINE CONTAMINATION
SUBMERSION
MAN
EXTERNAL
AIRBORNE RELEASE
DIRECT CONTAMINATION
LIQUID RELEASE
DIRECT CONTAMINATION
SOIL
INDIRECT CONTAMINATION
INHALATION
VEGETATION
ANIMALS
POTABLE WATER
FISH SEA FOODS
INGESTION
INGESTION
MEAT, MILK
DRINKING WATER
INGESTION
MAN
INTERNAL

FIGURE 5

PATHWAYS FOR EXTERNAL AND INTERNAL EXPOSURE OF MAN FROM AIRBORNE AND LIQUID RELEASES OF RADIOACTIVE EFFLUENTS

TABLE 5 RADIONUCLIDE RELEASES ASSUMED FOR ENVIRONMENTAL PATHWAYS ANALYSIS

	Assumed Annual Release, Curie	
Radionuclide	Liquid Release	Airborne Release
Cobalt 60	0.001	0.001
Tritium	0.100	0.001
Carbon 14	*	0.100
Krypton 83m	*	0.020
Krypton 85m	*	0.024
Krypton 85	*	0.001
Krypton 87	*	0.050
Krypton 88	*	0.020
Xenon 131m	*	0.005
Xenon 133m	*	0.010
Xenon 133	*	0.210
Xenon 135	*	0.250
Argon 41	*	0.410

*These gaseous radionuclides are released into the air, not into water.

TABLE 6 ENVIRONMENTAL EXPOSURE TIMES, CONSUMPTION AND CONCENTRATION PARAMETERS ASSUMED FOR ENVIRONMENTAL PATHWAYS ANALYSIS

Pathway Parameter*	Assumed Parameter Value For Highest Individual	For Average Individual
Fraction of Year Occupancy		
For Air Immersion	1	1
For Land Deposition	1	1
Along Shoreline	.05	.0005
Swimming	.01	.0001
Boating	.01	.0001
Food Consumption		
Leafy vegetables, Kg/year	72	18
Water, liters/year	730	180
Fish,** Kg/year	18	2.3
Mollusks,** Kg/year	9	.25
Crustacea,** Kg/year	9	.90
Sediment, Kg/year	1	.10

* Refer to Figure 5

** Cobalt 60 was assumed to concentrate from sea water to the edible flesh of fish, mollusks, and crustacea by factors as follows: fish, 650; mollusks, 170; crustacea, 1700, based on reference 38.

TABLE 7 ESTIMATED MAXIMUM RADIATION EXPOSURE TO AN INDIVIDUAL FOR ASSUMED LIQUID AND AIRBORNE RADIOACTIVITY RELEASES FROM SHIPYARDS ENGAGED IN NAVAL NUCLEAR PROPULSION WORK

	Maximum Exposure To An Individual	
	NRC Guideline millirem/year	Estimated Value millirem/year
From Radionuclides In Liquid Releases	3 whole body, or 10 any organ	less than 1
From Gaseous Radionuclides In Airborne Releases	5 whole body, or 15 skin	less than 1
From Other Radionuclides In Airborne Releases	15 any organ	less than 1

TABLE 8 ESTIMATED TOTAL WHOLE BODY RADIATION EXPOSURE TO GENERAL PUBLIC WITHIN 50 MILES FOR ASSUMED LIQUID AND AIRBORNE RADIOACTIVITY RELEASES FROM SHIPYARDS ENGAGED IN NAVAL NUCLEAR PROPULSION WORK

Exposure Due to Natural Background Radiation	Exposure Due to Assumed Radioactive Releases
Approximately 100,000 man rem per year	less than 1 man rem per year

AUDITS AND REVIEWS

The requirements and procedures for control of radioactive waste are important parts of the training programs for everyone involved with radioactivity in the Naval nuclear propulsion program. Such training is part of the initial qualification of shipyard workers and of Naval personnel assigned to ships and bases, and is required to be repeated regularly. Emphasis on this training is part of the concept that radiological control personnel alone cannot cause radiological work to be well performed; production and operations personnel and all levels of management are required to be involved in the control of radioactivity.

Checks and balances of several kinds are also set up to help ensure control of radioactivity. First, written procedures exist which require verbatim compliance. Radiological control personnel monitor various steps in radioactive waste processing. In each shipyard an independent organization, separate from the radiological control organization, audits all aspects of radioactive waste processing. Audits are performed by representatives from Naval Reactors headquarters who are assigned full time at each shipyard. Radiological control personnel from headquarters also conduct periodic inspections of each shipyard. In addition, shipyards have made detailed assessments of the environmental effects of shipyard operations and have published reports on the results of these assessments. Similarly, there are multiple levels of audits and inspections for the other Navy shore facilities, tenders, and nuclear-powered ships and for other radiologically controlled functions such as transportation. Even the smallest audit findings are followed up to ensure proper recovery and permanent corrective actions are taken and to help minimize the potential for future deficiencies.

The policy of the Navy is to provide for close cooperation and effective communication with state radiological officials involving occurrences that might cause concern because of radiological effects outside the ships or shore facilities. The Navy has reviewed radioactive waste disposal, radiological environmental monitoring, transportation and other radiological matters with state radiological officials in the states where Navy nuclear-powered ships are based or overhauled. Although there were no occurrences in 1980 which resulted in radiological effects to the public outside these facilities, states were notified when inquiries showed public interest in the possibility that such events had occurred. The Navy has encouraged states to conduct independent radiological environmental monitoring in harbors where Naval nuclear-powered ships are based or overhauled; the results of monitoring by states have been consistent with Navy results.

The U. S. Environmental Protection Agency (EPA) conducts detailed reviews of the Navy's procedures for controlling radioactive waste and for radiological environmental monitoring. An EPA laboratory has conducted detailed environmental surveys of selected U. S. harbors (references 34, 41, 42, 43, 44, 45). This laboratory has performed these surveys in the harbors at Charleston, South Carolina; Pearl Harbor, Hawaii; San Diego, California; Vallejo, California; New London, Connecticut; Newport News, Virginia; Norfolk, Virginia; Bremerton, Washington; and Kittery, Maine—Portsmouth, New Hampshire. EPA results have been consistent with Navy results. In the latest such EPA survey conducted in 1977 at the Portsmouth Naval Shipyard, EPA analyzed harbor water, sediment, marine life and air for radioactivity. No radioactivity from shipyard operations was detected.

CONCLUSIONS

1. The total gamma radioactivity in liquids, less tritium, released into all ports and harbors from the U. S. Naval nuclear propulsion program was less than 0.002 curie in 1980. The total tritium released into all ports and harbors was less than one curie in 1980.

2. No increase of radioactivity above normal background levels has been detected in harbor water where U. S. Naval nuclear-powered ships are based, overhauled, or constructed.

3. Liquid wastes from U. S. Naval nuclear-powered ships and support facilities have not caused a measurable increase in the general background radioactivity of the environment.

4. Low-level cobalt 60 radioactivity in harbor bottom sediment is detectable around a few operating base and shipyard piers from low level liquid releases in the 1960's. Cobalt 60 is not detectable above background levels in general harbor bottom areas away from these piers. Maximum total radioactivity observed in a U. S. harbor of less than 0.05 curie of cobalt 60 is small compared to the naturally occurring radioactivity. Comparison to previous environmental data summarized in references 1 through 15 shows that these environmental cobalt 60 levels are continuing to decrease.

5. Conservative estimates of radiation exposures to members of the public from the Naval nuclear propulsion program are far less than either the Environmental Protection Agency environmental standards, the guidelines of the Nuclear Regulatory Commission or the exposure from natural background radioactivity.

6. Procedures used by the Navy to control discharges of radioactivity from U. S. Naval nuclear-powered ships and their support facilities have been effective in protecting the environment and the health and safety of the general public. Independent radiological environmental monitoring performed by the U. S. Environmental Protection Agency and states have confirmed the adequacy of these procedures.

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(32) U. S. Department of Energy Report, "The 1979 State-by-State Assessment of Low-Level Radioactive Wastes Shipped to Commercial Burial Grounds," by B. D. Guilbeault, NUS Corporation, NUS-3440, November 1980.

(33) U. S. Nuclear Regulatory Commission, "Final Environmental Statement on the Transportation of Material By Air and Other Modes," NUREG-0170, December 1977.

(34) U. S. Environmental Protection Agency Report—"Radiological Surveys of Pearl Harbor, Hawaii, and Environs," by D. F. Cahill, H. D. Harvey, Jr., et al., issued in Radiation Data and Reports, June 1972.

(35) U. S. Energy Research and Development Administration, ERDA 1537, Final Environmental Statement, "Waste Management Operations, Savannah River Plant."

(36) U. S. Environmental Protection Agency Report—"Environmental Radiation Effects of Nuclear Facilities in New York State," by M. S. Terpilak and B. L. Jorgensen, issued in Radiation Data and Reports, July 1974.

(37) U. S. Nuclear Regulatory Commission, Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I."

(38) "Concentration Factors in the Aquatic Environment," S. M. Jinks and M. Eisenbud, issued in Radiation Data and Reports, May 1972.

(39) Code of Federal Regulations, Title 40 (Environmental Protection Agency), Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

(40) U. S. Environmental Protection Agency Report—"Radiological Quality of the Environment in the United States, 1977," by Kurt L. Feldman et. al., EPA Report-520/1-77-009, September 1977.

(41) U. S. Public Health Service Report—"Radiological Survey of Major California Nuclear Ports," by D. F. Cahill, D. C. McCurry and W. D. Breakfield, Clearinghouse for Federal Scientific and Technical Information No. PH178728, April 1968.

(42) U. S. Environmental Protection Agency Report—"Radiological Survey of New London Harbor, Thames River Connecticut and Environs," by S. T. Windham and C. R. Phillips, issued in Radiation Data and Reports, November 1973.

(43) U. S. Public Health Service Report—"Radiological Survey of Hampton Roads (Norfolk—Newport News), Virginia," by H. D. Harvey, Jr., E. D. Toerber and J. A. Gordon, Clearinghouse for Federal Scientific and Technical Information No. AD683208, January 1968.

(44) U. S. Environmental Protection Agency Report—"Radiological Survey of Puget Sound Naval Shipyard, Bremerton, Washington, and Environs," by R. S. Callis, S. T. Windham, and C. R. Phillips, EPA Report—520/5/77-001, February 1977.

(45) U. S. Environmental Protection Agency Report—"Radiological Survey of Portsmouth Naval Shipyard, Kittery, Maine and Environs," by R. S. Callis, S. T. Windham and C. R. Phillips, EPA Report 520/5-79-003, July 1979.

APPENDIX
ENVIRONMENTAL MONITORING SURVEY CHARTS

Environmental monitoring survey charts for harbors monitored for radioactivity associated with U. S. Naval nuclear-powered ships in the U. S. and possessions during 1980 are listed below and included in this appendix. The sampling locations for harbor water and harbor sediment are shown. In addition, shoreline survey areas and the locations of posted dosimetry devices are shown on the figures.

Figure No.	Location
	California
1	U. S. Naval Air Station, Alameda
2	Hunters Point Naval Shipyard, San Francisco
3	Mare Island Naval Shipayrd, Vallejo
4	Long Beach Harbor
5	Long Beach Harbor, Anaheim Bay Area
6	San Diego Harbor
7	San Diego Harbor, Ballast Point Area
	Connecticut
8	Electric Boat Division, Groton
9	U. S. Naval Submarine Support Facility, New London Harbor
10	State Pier Area, New London
	Florida
11	Port Canaveral
	Georgia
12	U. S. Naval Submarine Support Facility, Kings Bay
	Guam
13	Apra Harbor
	Hawaii
14	Pearl Harbor Area
15	Pearl Harbor Naval Shipyard
16	U. S. Naval Submarine Base, Pearl Harbor
	Mississippi
17	Ingalls Shipbuilding Division, Pascagoula
	New Hampshire/Maine
18	Portsmouth Naval Shipyard

South Carolina
19 U. S. Naval Station and Naval Shipyard, Charleston
20 U. S. Naval Weapons Station, Charleston

Virginia
21 Newport News Shipbuilding and Dry Dock Co., Newport News
22 Norfolk Naval Shipyard, Portsmouth
23 U. S. Naval Station Norfolk, Destroyer and Submarine Piers
24 Norfolk— Portsmouth Virginia Area

Washington
25 Puget Sound Naval Shipyard
26 Bangor/Hood Canal

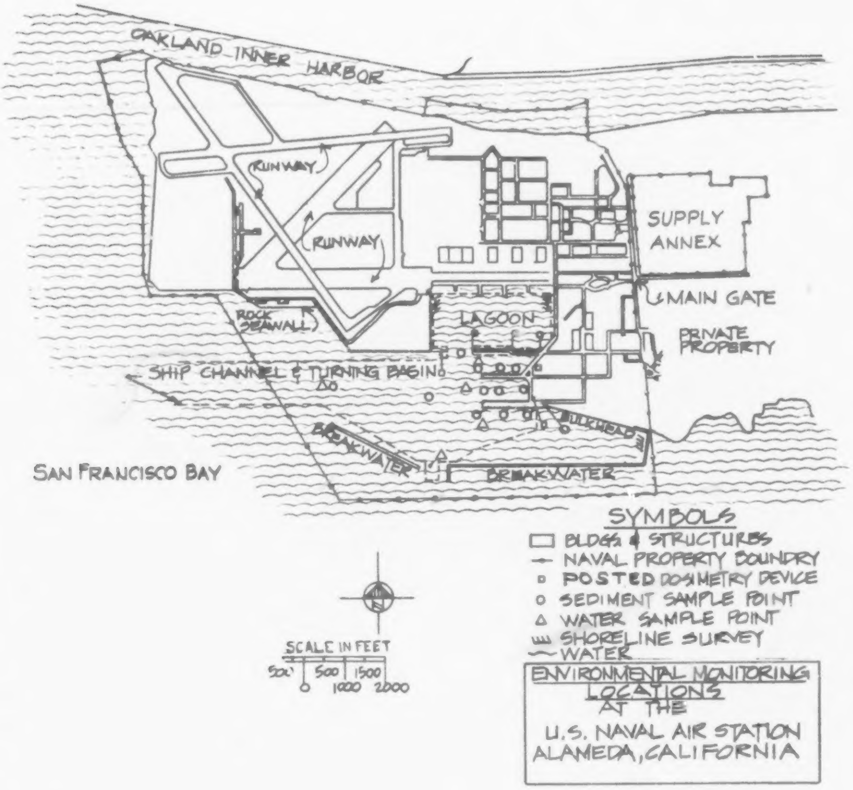

OAKLAND INNER HARBOR
RUNWAY
RUNWAY
SUPPLY ANNEX
MAIN GATE
ROCK SEAWALL
LAGOON
PRIVATE PROPERTY
SHIP CHANNEL & TURNING BASIN
BULKHEAD
BREAKWATER
BREAKWATER
SAN FRANCISCO BAY
N
SCALE IN FEET
500'
500
1500
0
1000
2000
SYMBOLS
BLDGS & STRUCTURES
NAVAL PROPERTY BOUNDRY
POSTED DOSIMETRY DEVICE
SEDIMENT SAMPLE POINT
WATER SAMPLE POINT
SHORELINE SURVEY
WATER
ENVIRONMENTAL MONITORING LOCATIONS AT THE
U.S. NAVAL AIR STATION ALAMEDA, CALIFORNIA

FIGURE 1

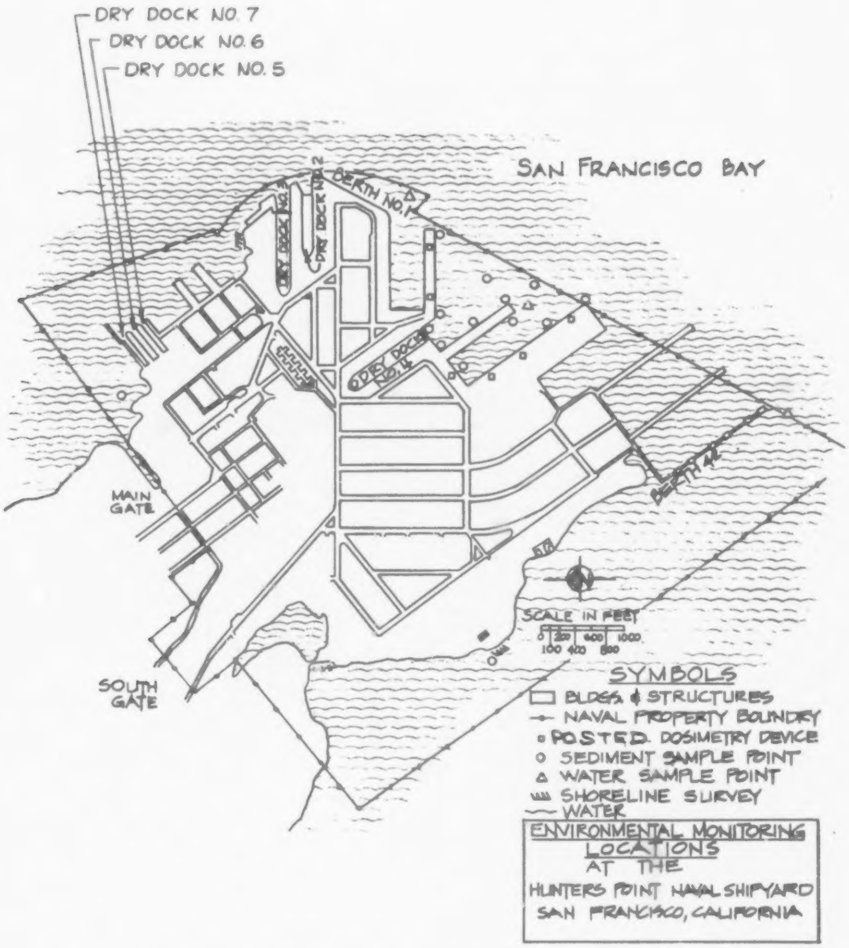

DRY DOCK NO. 7
DRY DOCK NO. 6
DRY DOCK NO. 5
SAN FRANCISCO BAY
BERTH NO. 1
DRY DOCK NO. 3
DRY DOCK NO. 2
DRY DOCK NO. 4
BERTH 42
MAIN GATE
SOUTH GATE
SCALE IN FEET
0 200 600 1000
100 400 800
SYMBOLS
BLDGS. & STRUCTURES
NAVAL PROPERTY BOUNDRY
POSTED DOSIMETRY DEVICE
SEDIMENT SAMPLE POINT
WATER SAMPLE POINT
SHORELINE SURVEY
WATER
ENVIRONMENTAL MONITORING LOCATIONS AT THE
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

FIGURE 2

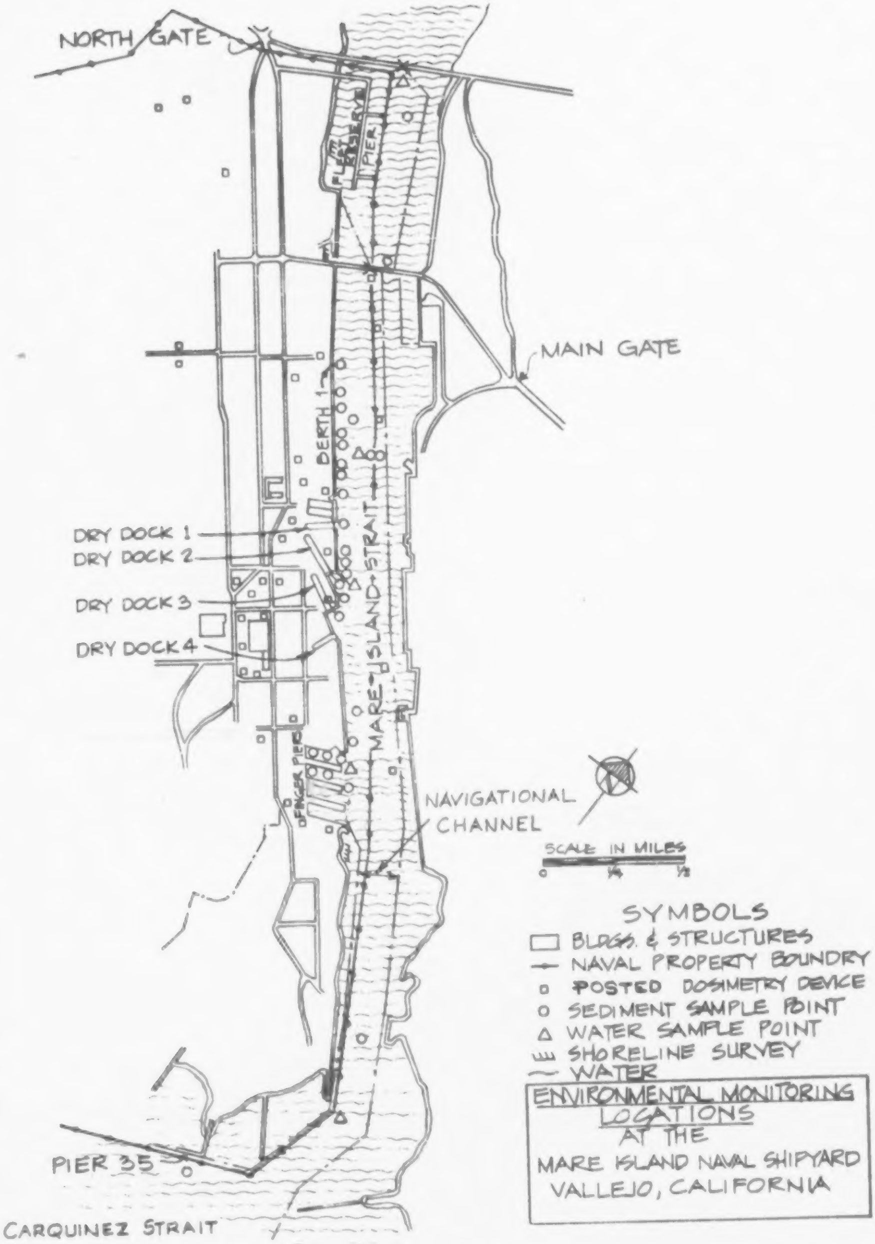

NORTH GATE
PIER
PIER
RESERVE
MAIN GATE
BERTH 1
MARE ISLAND STRAIT
DRY DOCK 1
DRY DOCK 2
DRY DOCK 3
DRY DOCK 4
FINGER PIER
NAVIGATIONAL CHANNEL
SCALE IN MILES
0
1/4
1/2
SYMBOLS
▭ BLDGS. & STRUCTURES
—•— NAVAL PROPERTY BOUNDRY
▫ POSTED DOSIMETRY DEVICE
○ SEDIMENT SAMPLE POINT
△ WATER SAMPLE POINT
ш SHORELINE SURVEY
~ WATER
ENVIRONMENTAL MONITORING LOCATIONS
AT THE
MARE ISLAND NAVAL SHIPYARD
VALLEJO, CALIFORNIA
PIER 35
CARQUINEZ STRAIT

FIGURE 3

ENVIRONMENTAL MONITORING SURVEY CHART LONG BEACH HARBOR, CALIFORNIA

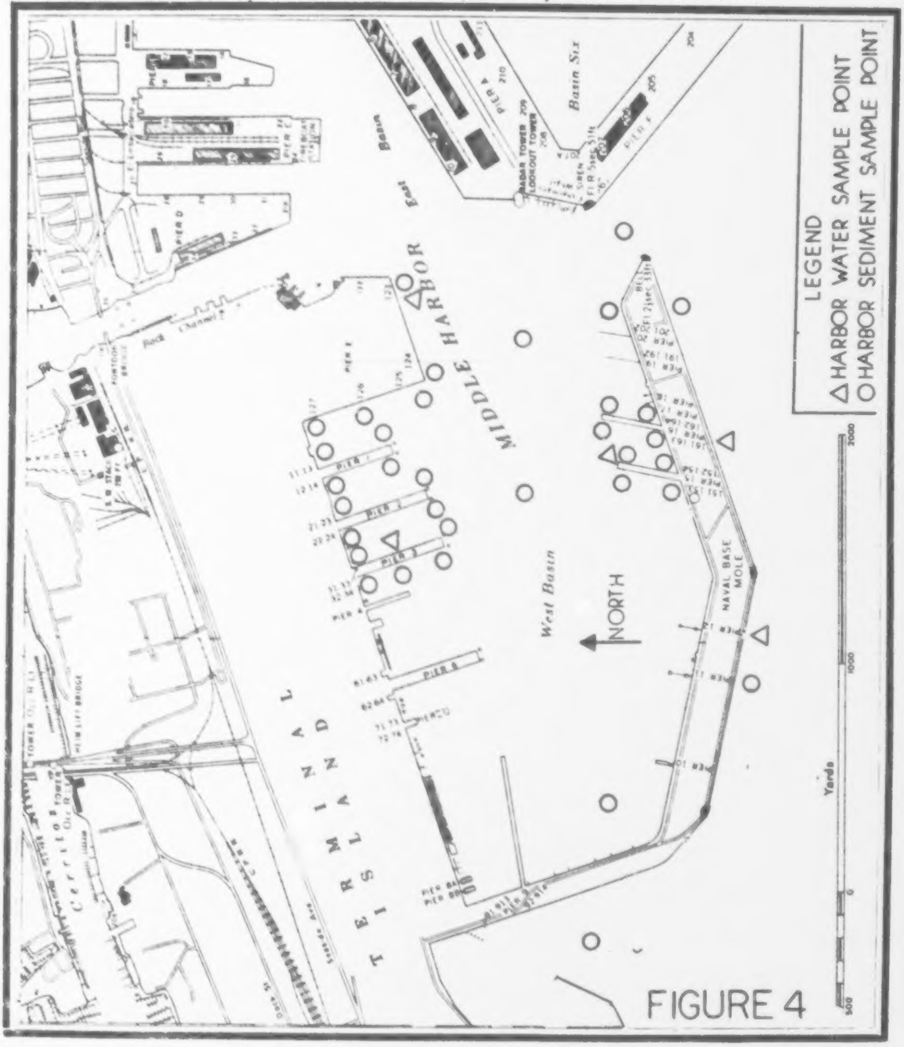

LEGEND
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT
MIDDLE HARBOR
TERMINAL ISLAND
West Basin
East Basin
Basin Six
NORTH
NAVAL BASE MOLE
PIER A
PIER 1
PIER 2
PIER 3
PIER 4
PIER 6
PIER E
PIER D
Rock Channel
Cerritos Channel
Yards
0
500
1000
2000

FIGURE 4

ENVIRONMENTAL MONITORING SURVEY CHART LONG BEACH, CALIFORNIA—ANAHEIM BAY AREA

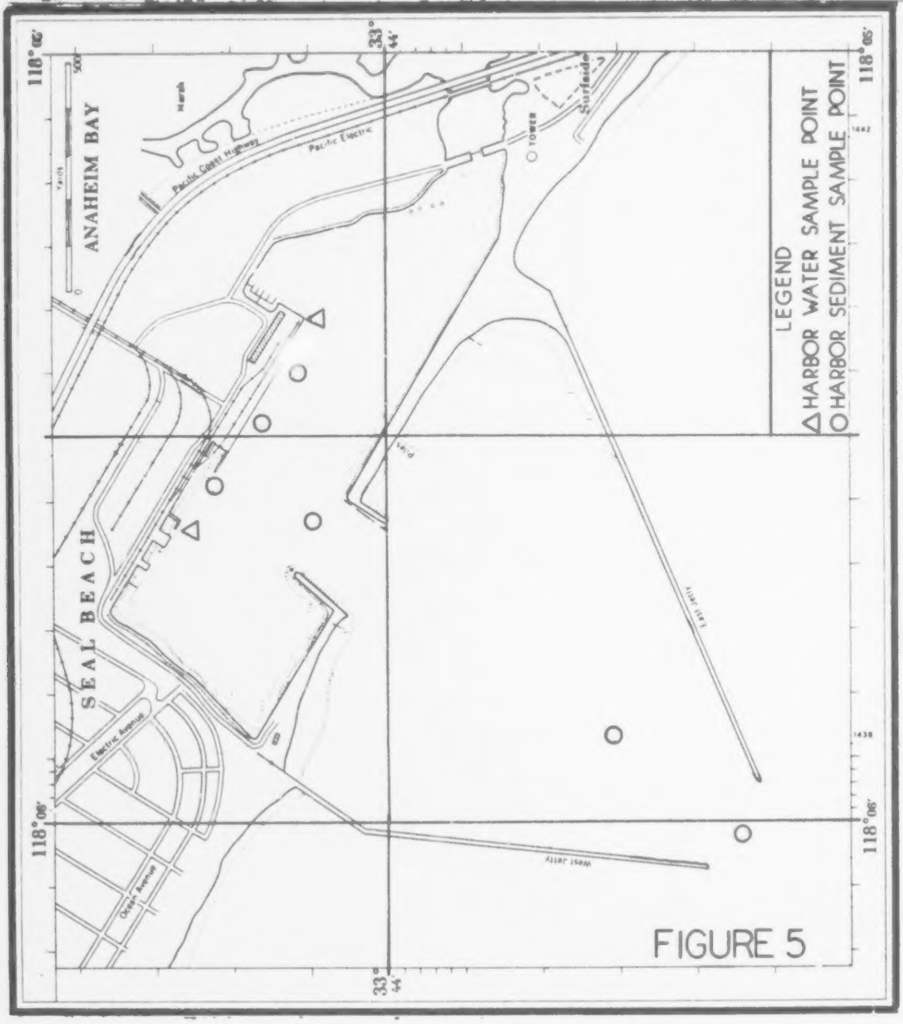

118°06'
33° 44'
118°05'
Yards
500
0
ANAHEIM BAY
Marsh
Pacific Coast Highway
Pacific Electric
TOWER
Surfside
Piers
East Jetty
West Jetty
SEAL BEACH
Electric Avenue
Ocean Avenue
LEGEND
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT

FIGURE 5

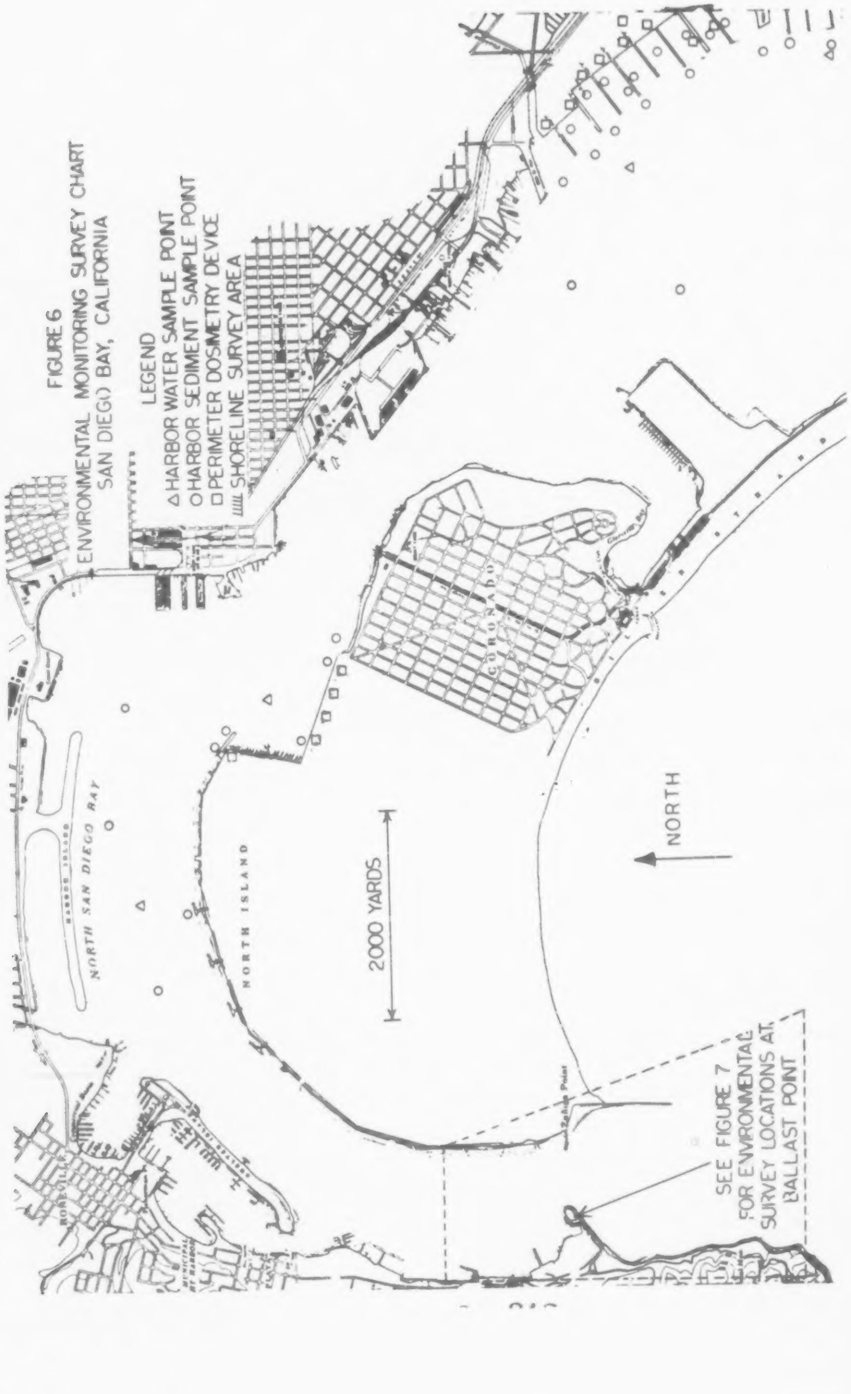


FIGURE 6
ENVIRONMENTAL MONITORING SURVEY CHART
SAN DIEGO BAY, CALIFORNIA

LEGEND
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
ШШ SHORELINE SURVEY AREA
HARBOR ISLAND
NORTH SAN DIEGO BAY
NORTH ISLAND
CORONADO
2000 YARDS
NORTH
SEE FIGURE 7
FOR ENVIRONMENTAL
SURVEY LOCATIONS AT
BALLAST POINT
ROSEVILLE

ENVIRONMENTAL MONITORING SURVEY CHART
BALLAST POINT, SAN DIEGO HARBOR

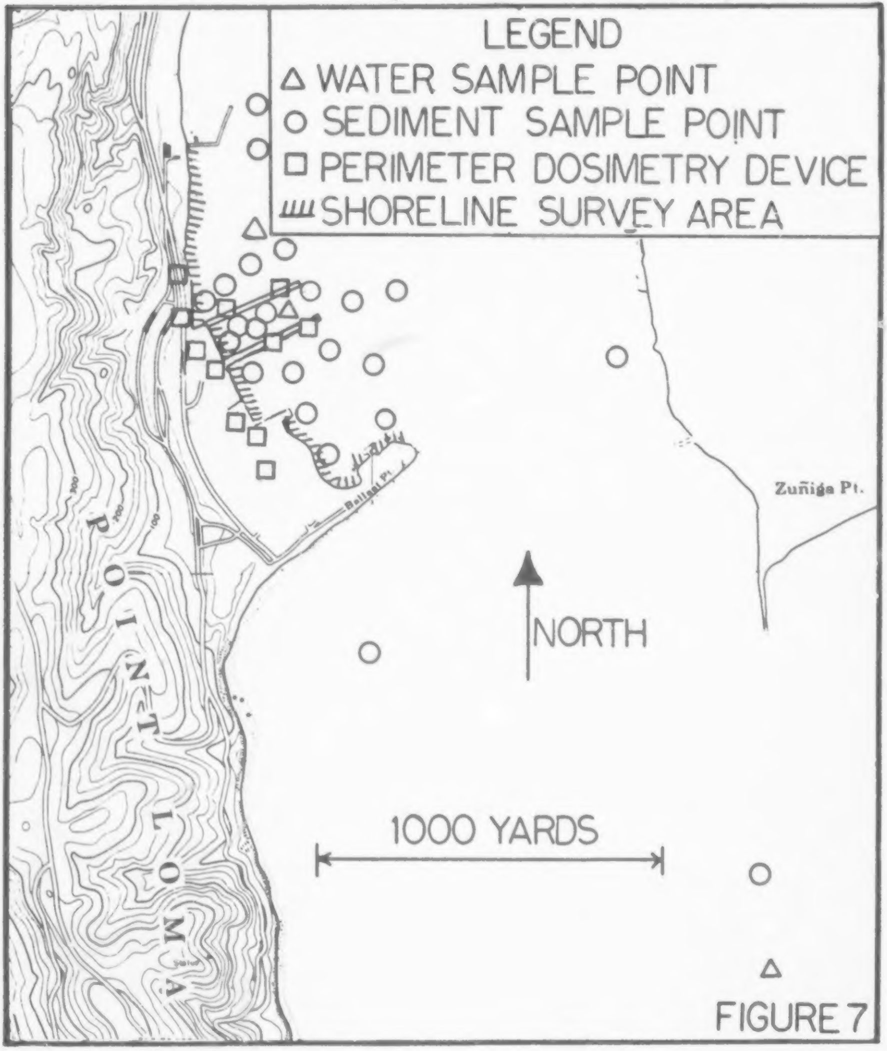

LEGEND
△ WATER SAMPLE POINT
○ SEDIMENT SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
ШШ SHORELINE SURVEY AREA
POINT LOMA
Ballast Pt.
Zuñiga Pt.
NORTH
1000 YARDS
300
200
100

FIGURE 7

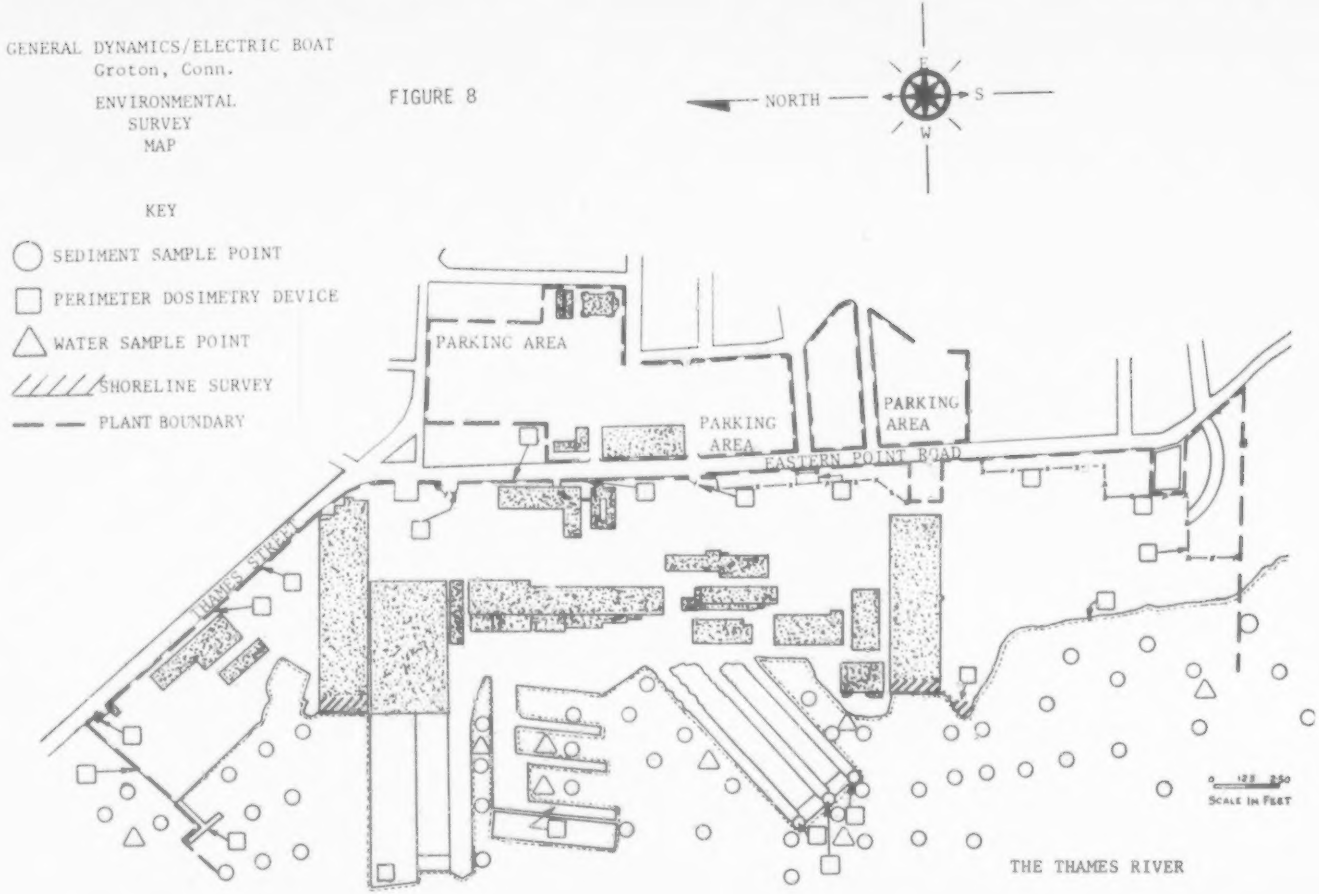


FIGURE 8

GENERAL DYNAMICS/ELECTRIC BOAT
Groton, Conn.

ENVIRONMENTAL
SURVEY
MAP

NORTH
E
S
W
KEY
SEDIMENT SAMPLE POINT
PERIMETER DOSIMETRY DEVICE
WATER SAMPLE POINT
SHORELINE SURVEY
PLANT BOUNDARY
PARKINC AREA
PARKING AREA
PARKING AREA
EASTERN POINT ROAD
THAMES STREET
THE THAMES RIVER
0 125 250
SCALE IN FEET

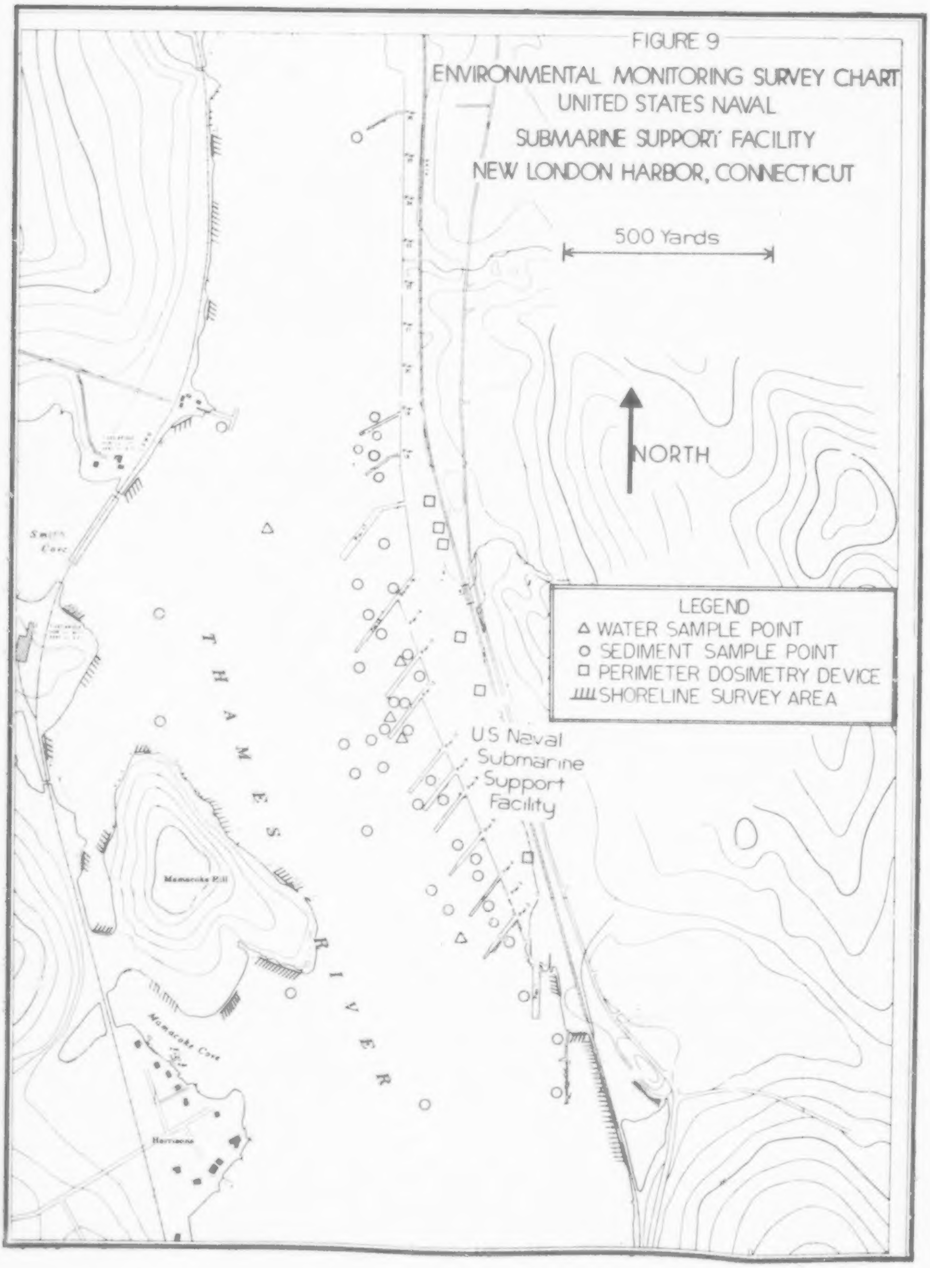


FIGURE 9
ENVIRONMENTAL MONITORING SURVEY CHART
UNITED STATES NAVAL
SUBMARINE SUPPORT FACILITY
NEW LONDON HARBOR, CONNECTICUT

500 Yards
NORTH
LEGEND
△ WATER SAMPLE POINT
○ SEDIMENT SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
ǁǁǁ SHORELINE SURVEY AREA
US Naval Submarine Support Facility
THAMES RIVER
Smith Cove
Mamacoke Hill
Mamacoke Cove
Harrisons

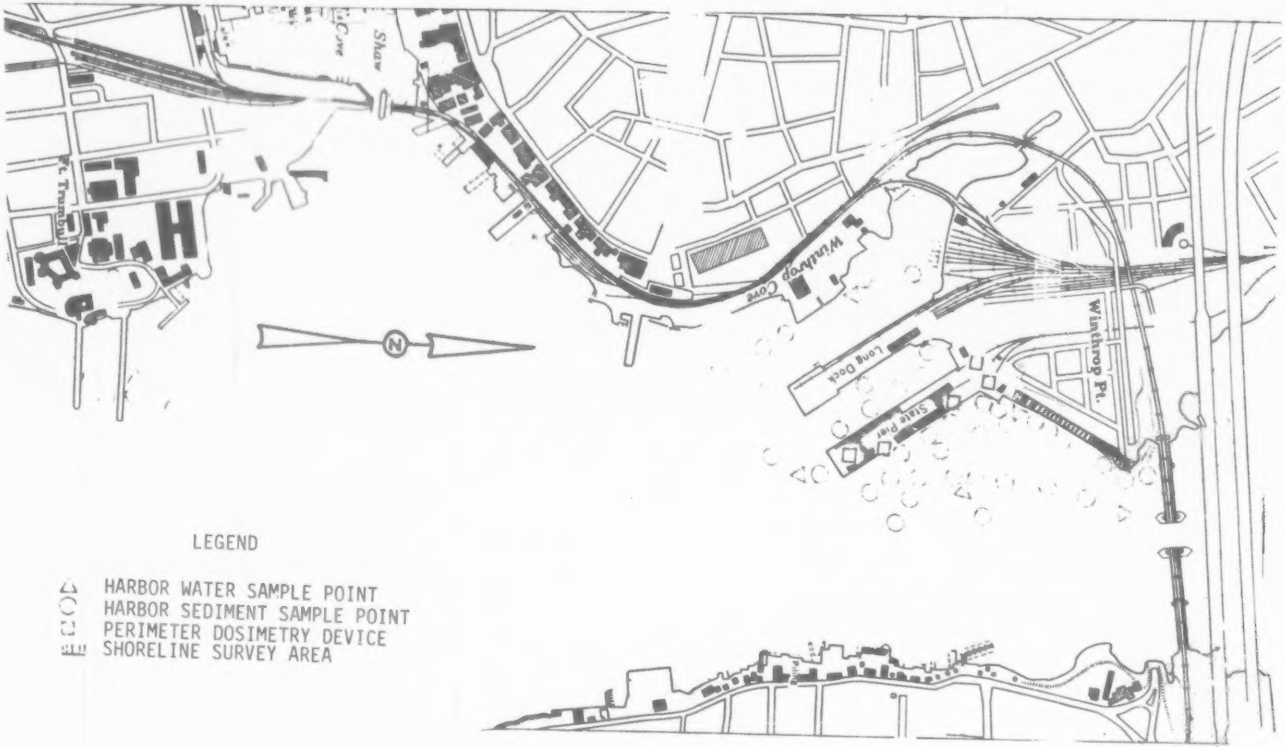

Ft. Trumbull
Shaw
Cove
N
Winthrop Cove
Long Dock
State Pier
Winthrop Pt.
LEGEND
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
▥ SHORELINE SURVEY AREA

FIGURE 10

ENVIRONMENTAL MONITORING SURVEY CHART
STATE PIER AREA, NEW LONDON,
CONNECTICUT

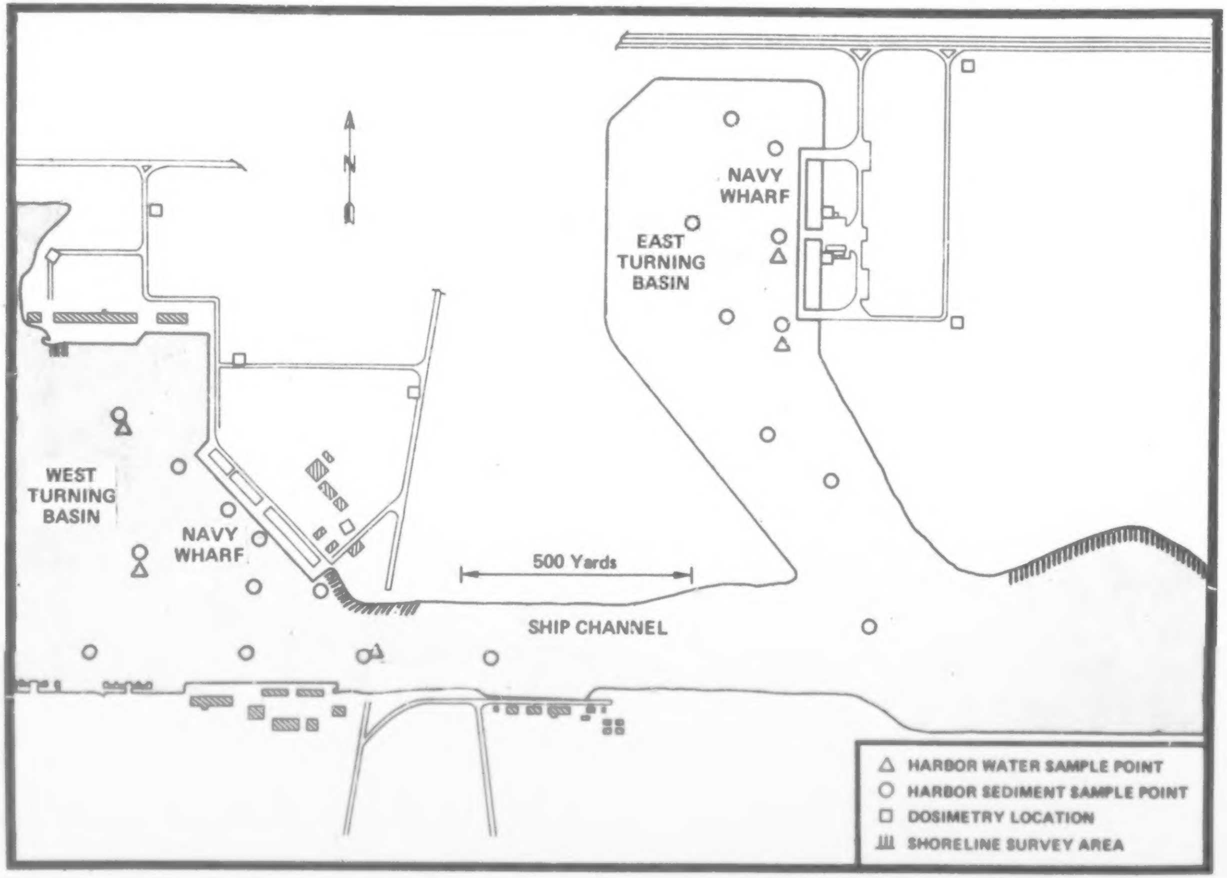
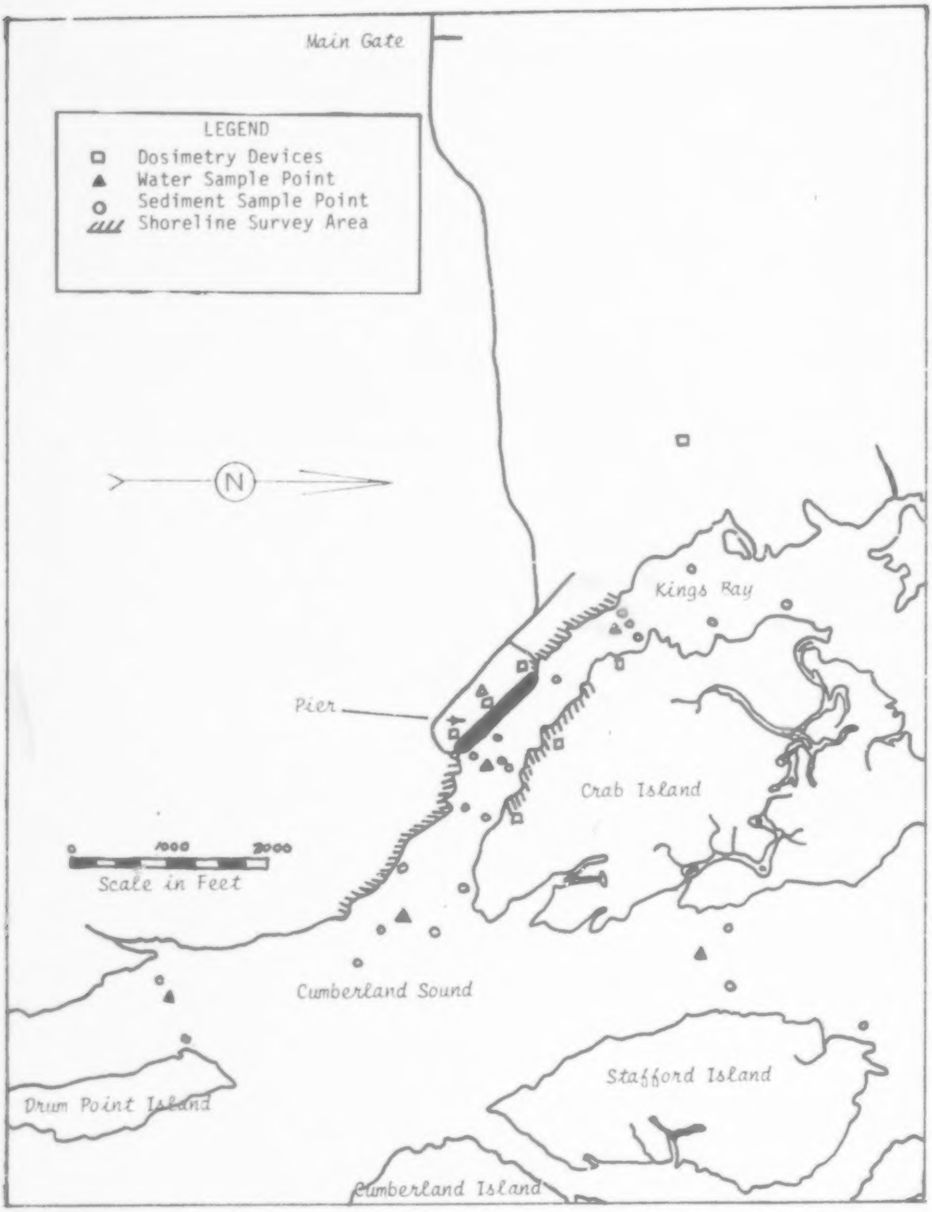

N
WEST
TURNING
BASIN
NAVY
WHARF
EAST
TURNING
BASIN
NAVY
WHARF
500 Yards
SHIP CHANNEL
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT
□ DOSIMETRY LOCATION
Ш SHORELINE SURVEY AREA

Figure 11. ENVIRONMENTAL MONITORING SURVEY CHART PORT CANAVERAL, FLORIDA


Main Gate
LEGEND
□ Dosimetry Devices
▲ Water Sample Point
○ Sediment Sample Point
Shoreline Survey Area
N
Kings Bay
Pier
Crab Island
0 1000 2000
Scale in Feet
Cumberland Sound
Stafford Island
Drum Point Island
Cumberland Island

Environmental Monitoring locations, Kings Bay Submarine Support Facility

FIGURE 12

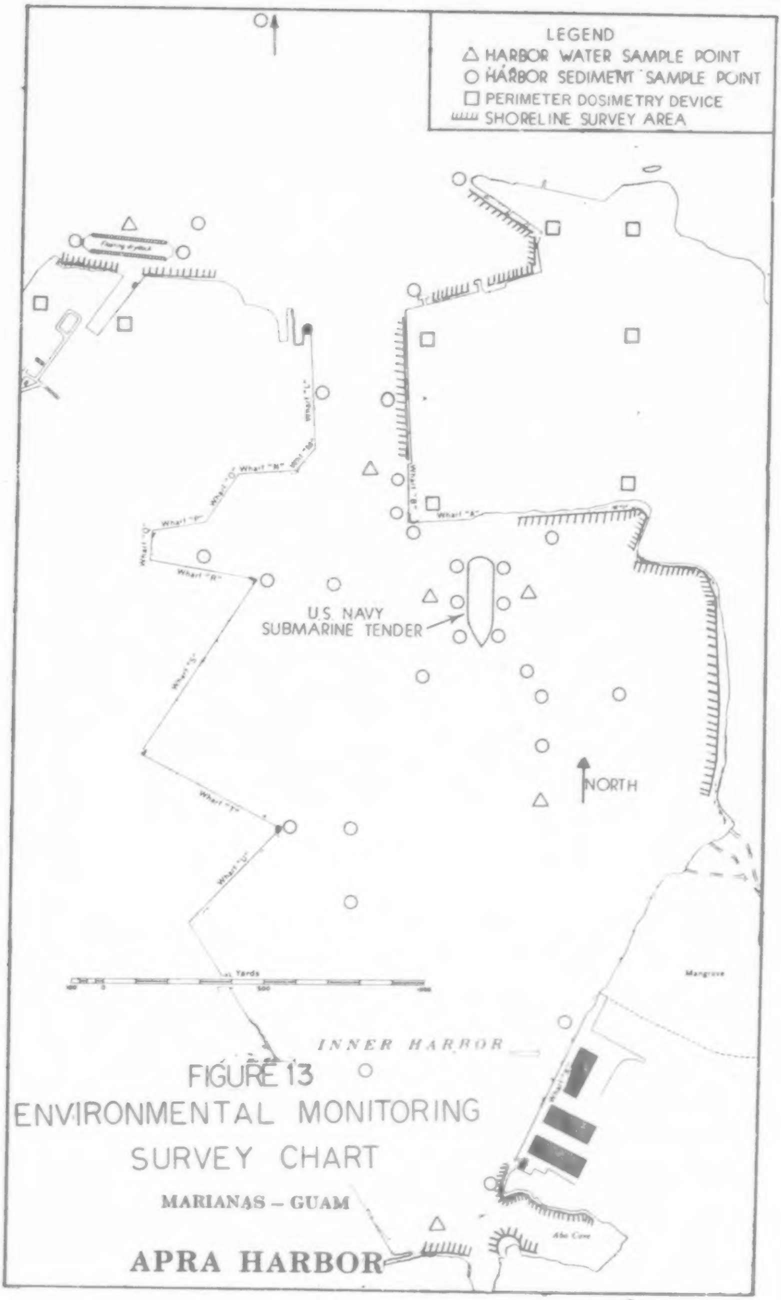
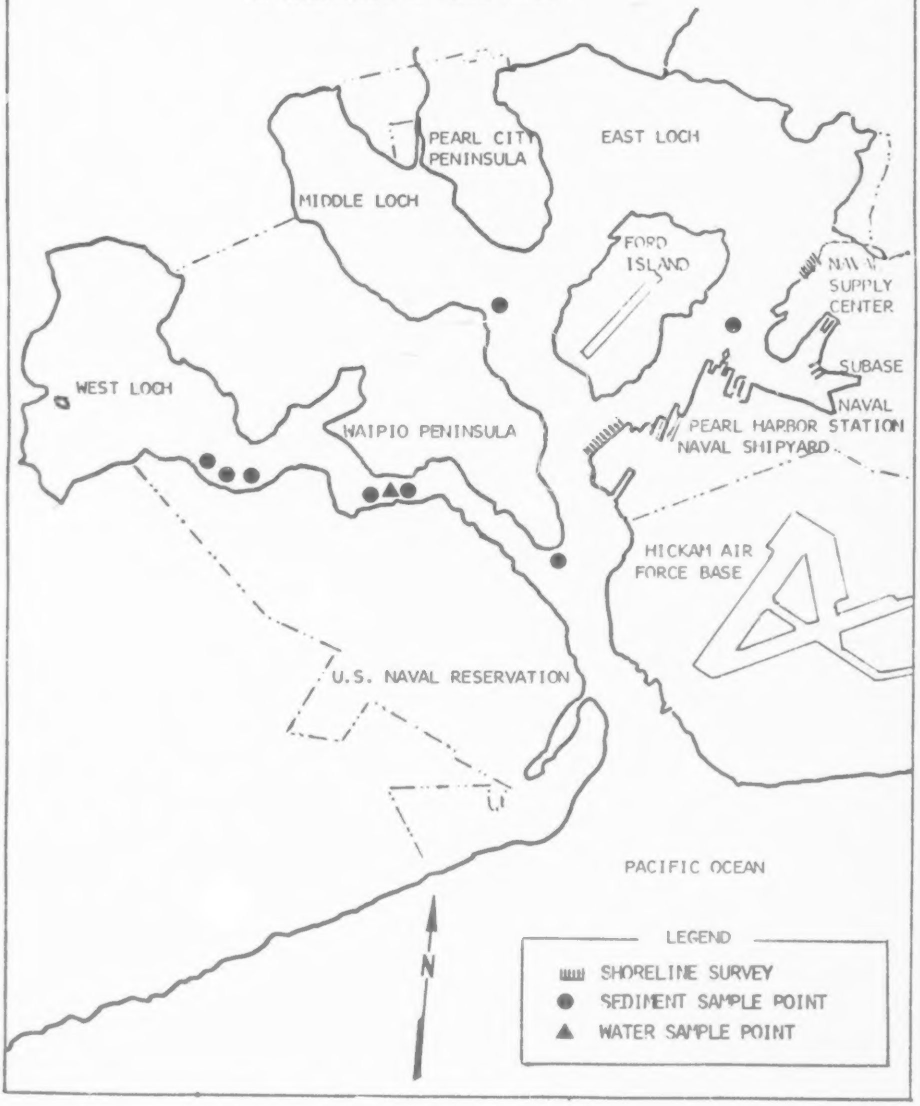

LEGEND
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT
☐ PERIMETER DOSIMETRY DEVICE
SHORELINE SURVEY AREA
Floating drydock
Wharf "L"
Wharf "M"
Wharf "N"
Wharf "O"
Wharf "P"
Wharf "Q"
Wharf "R"
Wharf "S"
Wharf "T"
Wharf "U"
Wharf "B"
Wharf "A"
U.S. NAVY
SUBMARINE TENDER
NORTH
Yards
INNER HARBOR
Mangrove
Abo Cove

FIGURE 13
ENVIRONMENTAL MONITORING
SURVEY CHART
MARIANAS – GUAM
APRA HARBOR

FIGURE 14

OVERALL MAP OF PEARL HARBOR SHOWING ENVIRONMENTAL MONITORING LOCATIONS IN OTHER AREAS OF PEARL HARBOR


PEARL CITY
PENINSULA
EAST LOCH
MIDDLE LOCH
FORD ISLAND
NAV
SUPPLY CENTER
SUBASE
NAVAL
PEARL HARBOR STATION
NAVAL SHIPYARD
WEST LOCH
WAIPIO PENINSULA
HICKAM AIR FORCE BASE
U.S. NAVAL RESERVATION
PACIFIC OCEAN
N
LEGEND
SHORELINE SURVEY
SEDIMENT SAMPLE POINT
WATER SAMPLE POINT

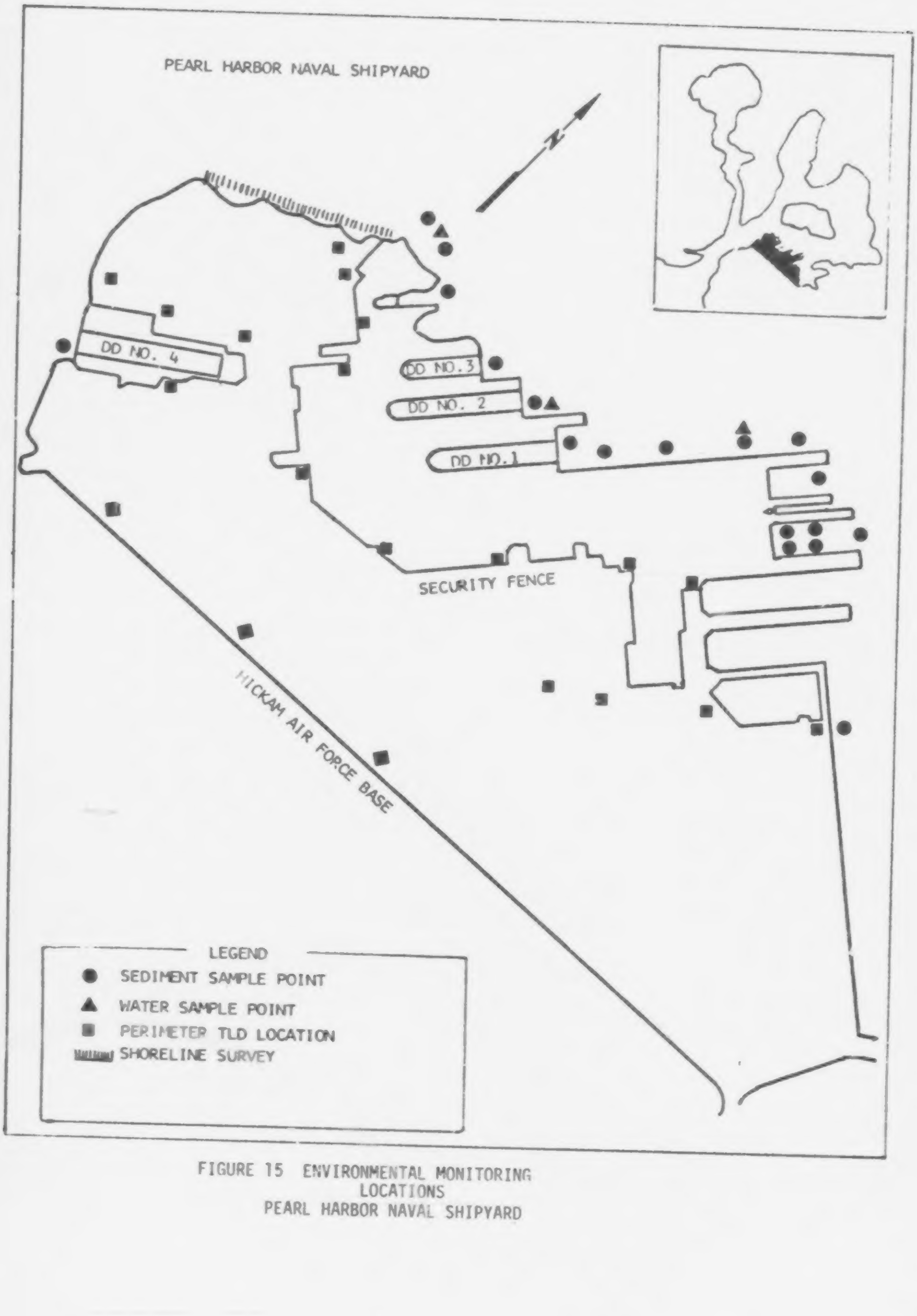

PEARL HARBOR NAVAL SHIPYARD
N
DD NO. 4
DD NO. 3
DD NO. 2
DD NO. 1
SECURITY FENCE
HICKAM AIR FORCE BASE
LEGEND
● SEDIMENT SAMPLE POINT
▲ WATER SAMPLE POINT
■ PERIMETER TLD LOCATION
SHORELINE SURVEY

FIGURE 15 ENVIRONMENTAL MONITORING LOCATIONS
PEARL HARBOR NAVAL SHIPYARD

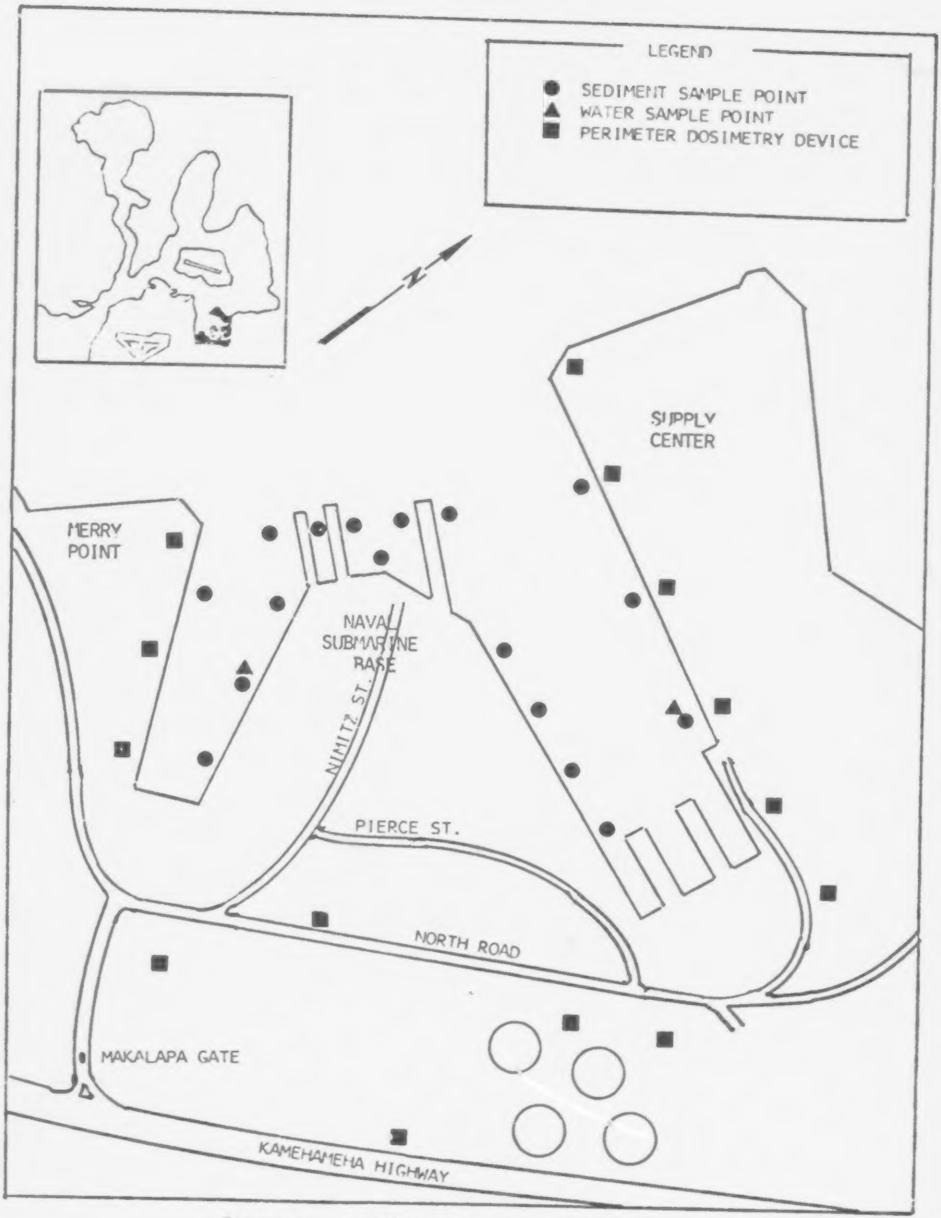
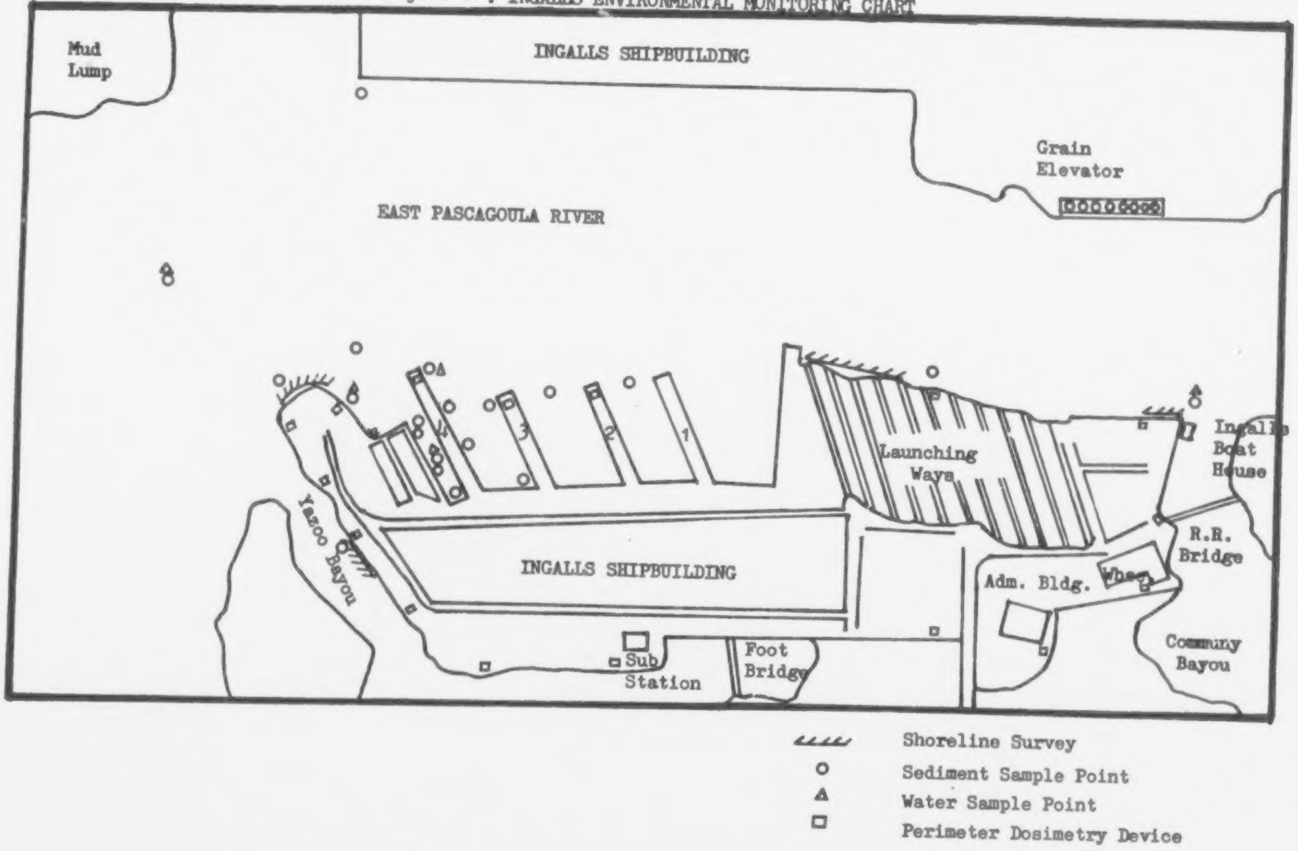

LEGEND
● SEDIMENT SAMPLE POINT
▲ WATER SAMPLE POINT
■ PERIMETER DOSIMETRY DEVICE
N
SUPPLY CENTER
MERRY POINT
NAVAL SUBMARINE BASE
NIMITZ ST.
PIERCE ST.
NORTH ROAD
MAKALAPA GATE
KAMEHAMEHA HIGHWAY

FIGURE 16 ENVIRONMENTAL MONITORING LOCATIONS
PEARL HARBOR NAVAL SUBMARINE BASE

Figure 17: INGALLS ENVIRONMENTAL MONITORING CHART


Mud Lump
INGALLS SHIPBUILDING
Grain Elevator
EAST PASCAGOULA RIVER
1
2
3
4
Launching Ways
Ingalls Boat House
R.R. Bridge
Adm. Bldg.
Whse.
Yazoo Bayou
INGALLS SHIPBUILDING
Sub Station
Foot Bridge
Community Bayou
Shoreline Survey
Sediment Sample Point
Water Sample Point
Perimeter Dosimetry Device

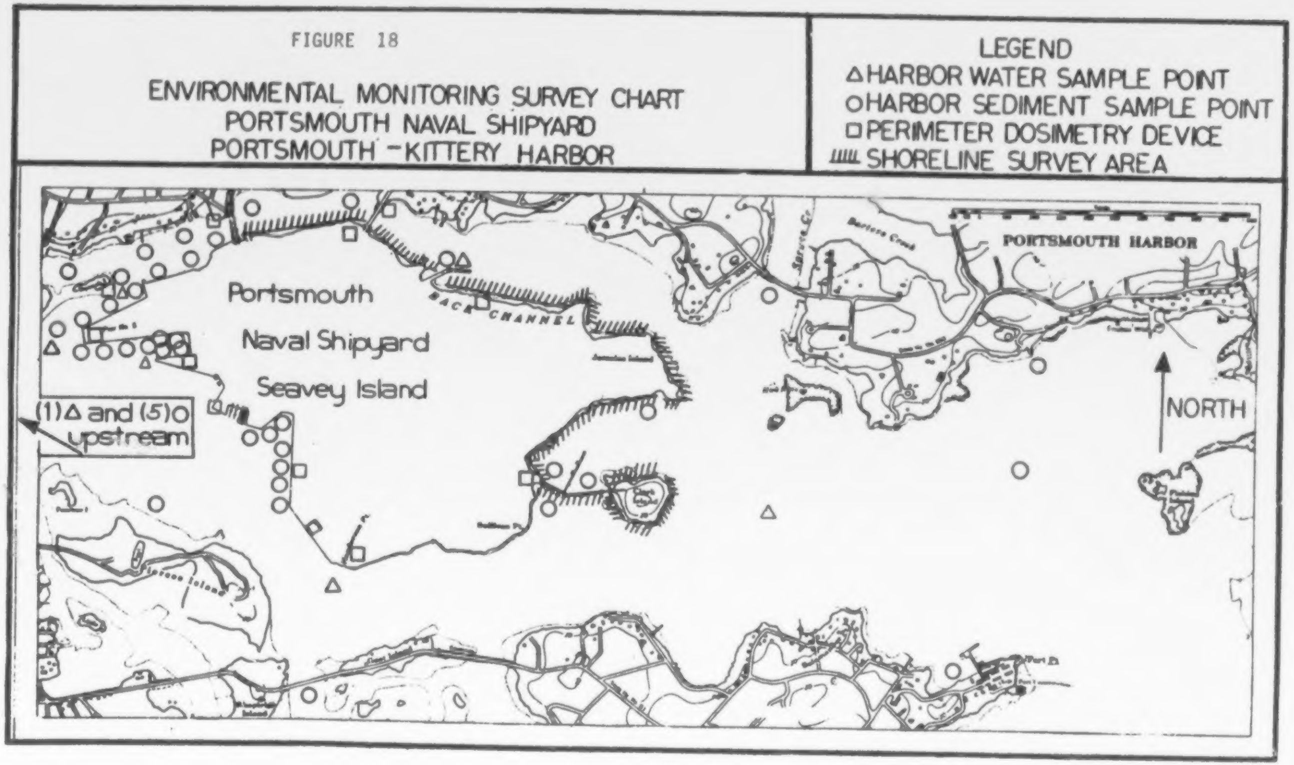


FIGURE 18

ENVIRONMENTAL MONITORING SURVEY CHART
PORTSMOUTH NAVAL SHIPYARD
PORTSMOUTH - KITTERY HARBOR

LEGEND
△ HARBOR WATER SAMPLE POINT
○ HARBOR SEDIMENT SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
ШШ SHORELINE SURVEY AREA
Portsmouth
Naval Shipyard
Seavey Island
BACK CHANNEL
(1) △ and (5) ○ upstream
NORTH
PORTSMOUTH HARBOR

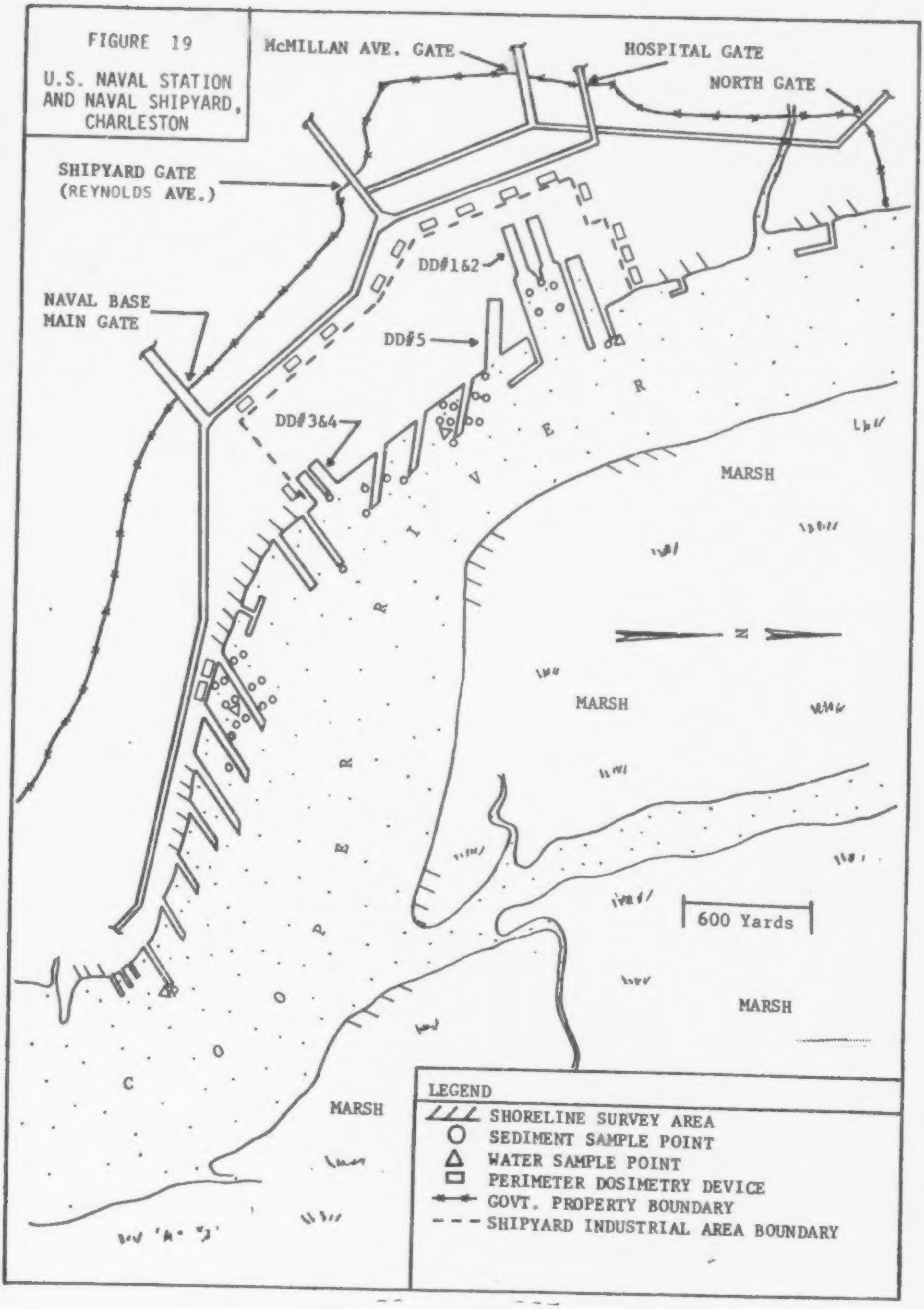


FIGURE 19

U.S. NAVAL STATION AND NAVAL SHIPYARD, CHARLESTON

McMILLAN AVE. GATE
HOSPITAL GATE
NORTH GATE
SHIPYARD GATE (REYNOLDS AVE.)
NAVAL BASE MAIN GATE
DD#1&2
DD#5
DD#3&4
COOPER RIVER
MARSH
MARSH
MARSH
MARSH
N
600 Yards
LEGEND
SHORELINE SURVEY AREA
O SEDIMENT SAMPLE POINT
Δ WATER SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
GOVT. PROPERTY BOUNDARY
SHIPYARD INDUSTRIAL AREA BOUNDARY

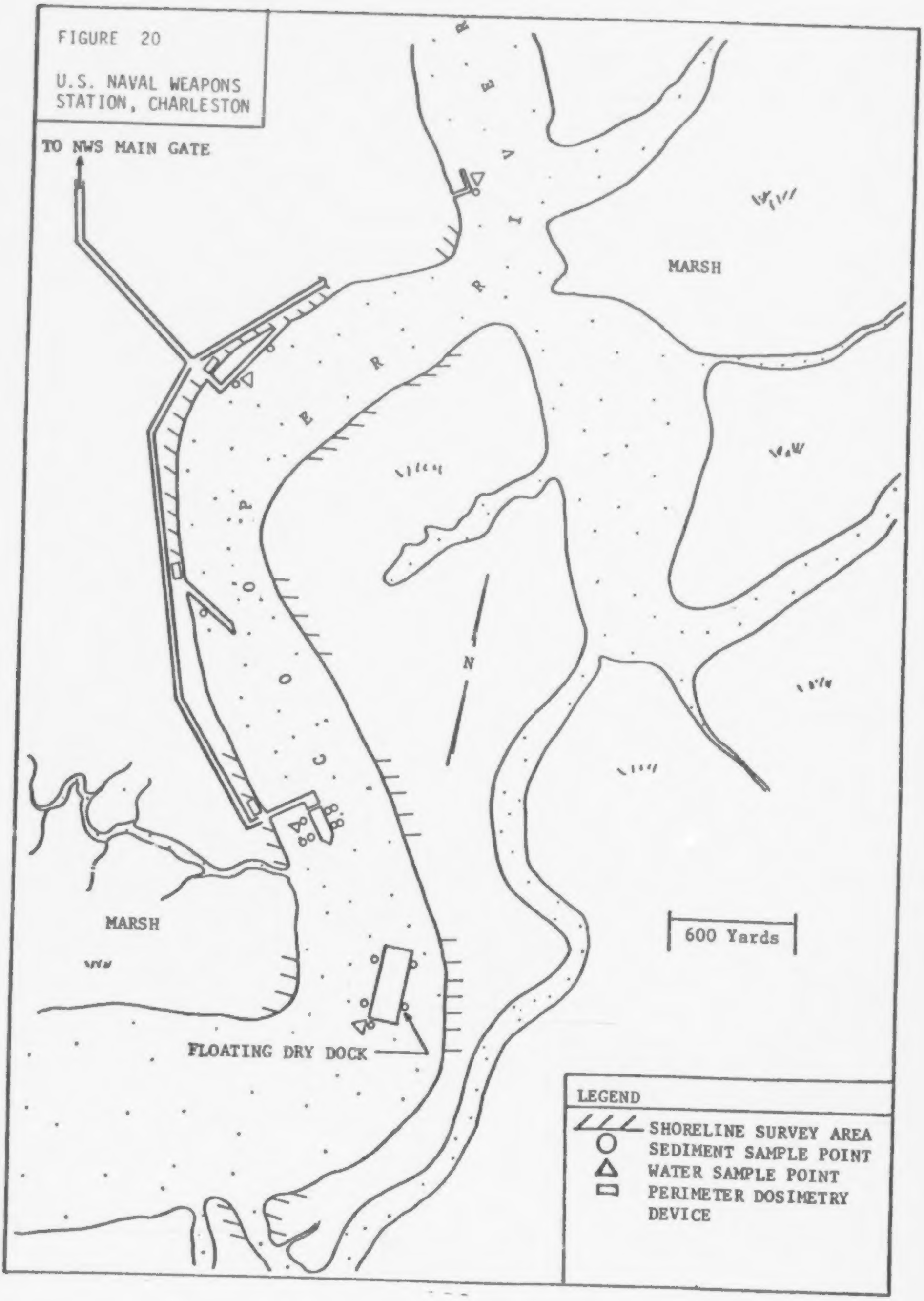


FIGURE 20

U.S. NAVAL WEAPONS STATION, CHARLESTON

TO NWS MAIN GATE
COOPER RIVER
MARSH
MARSH
N
600 Yards
FLOATING DRY DOCK
LEGEND
SHORELINE SURVEY AREA
SEDIMENT SAMPLE POINT
WATER SAMPLE POINT
PERIMETER DOSIMETRY DEVICE

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY
ENVIRONMENTAL MONITORING SURVEY LOCATIONS

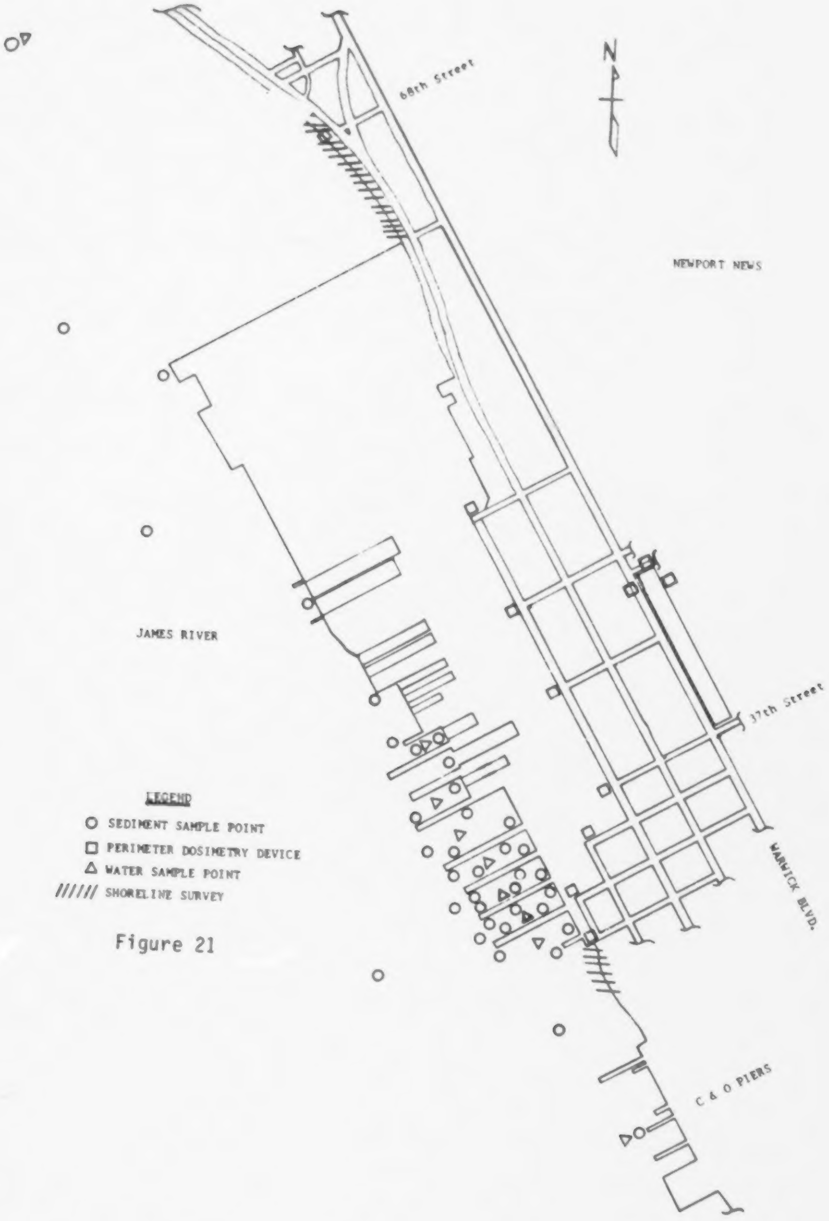

68th Street
N
NEWPORT NEWS
JAMES RIVER
37th Street
WARWICK BLVD.
C & O PIERS
LEGEND
○ SEDIMENT SAMPLE POINT
□ PERIMETER DOSIMETRY DEVICE
△ WATER SAMPLE POINT
////// SHORELINE SURVEY

Figure 21

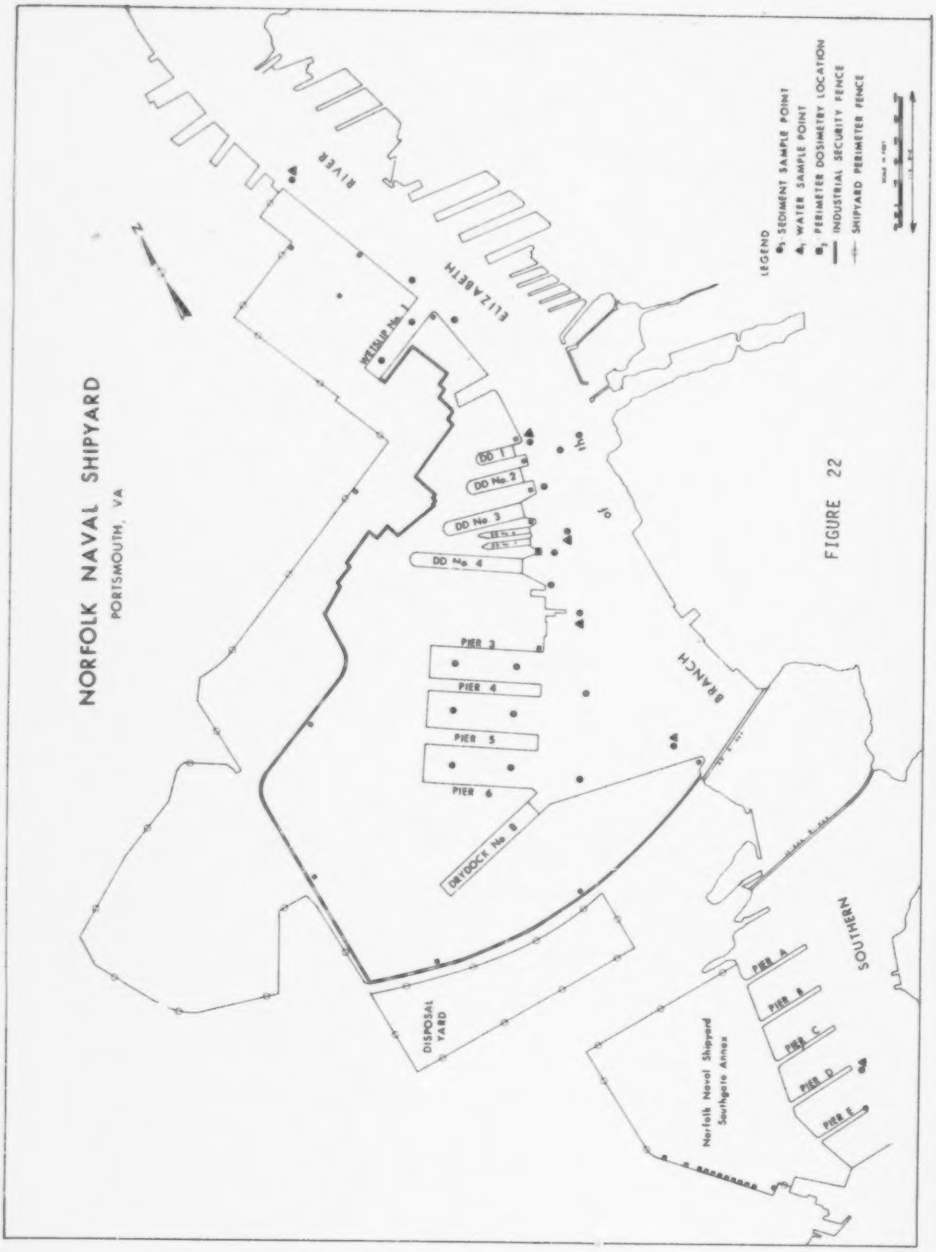
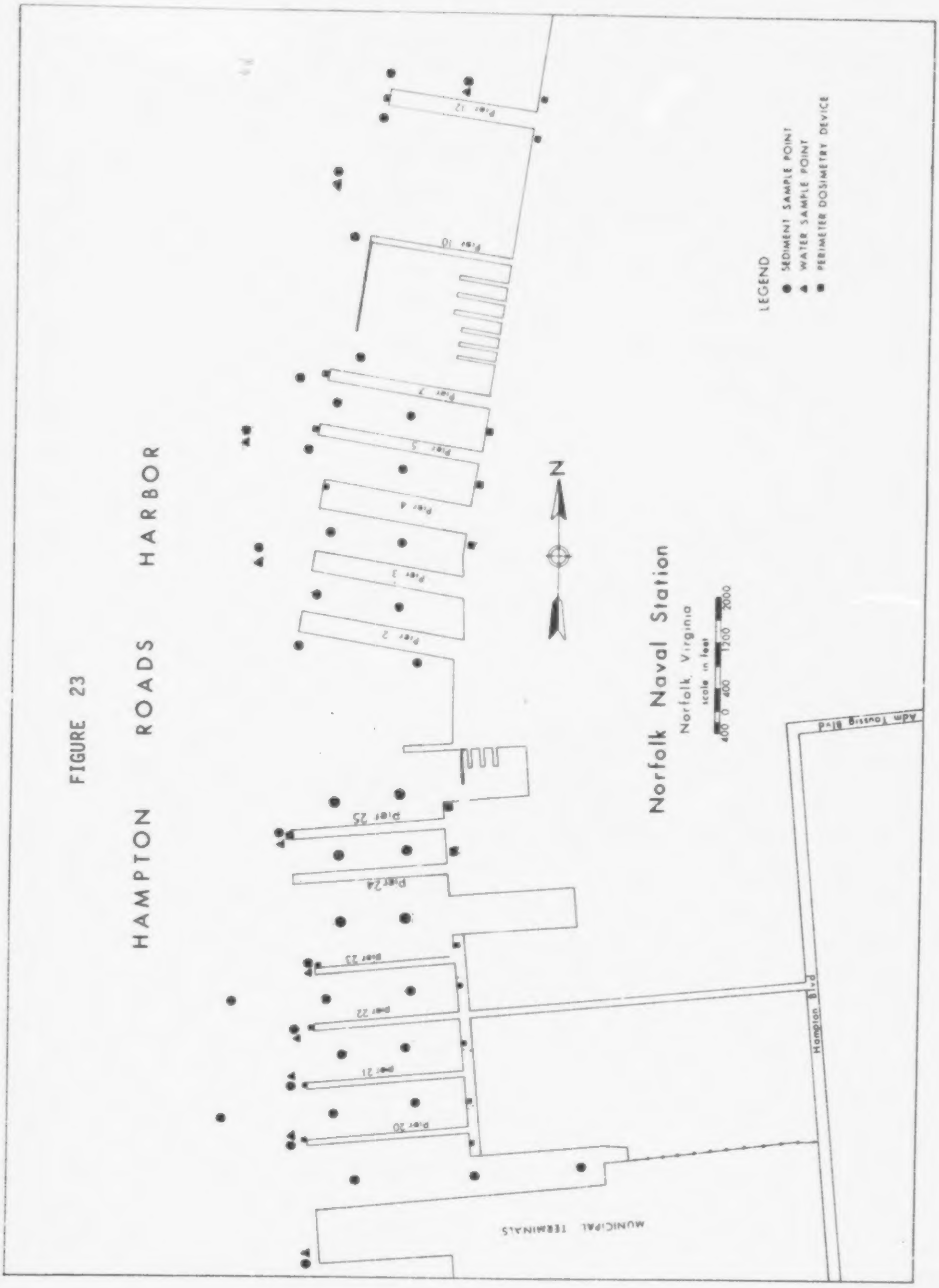

NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VA
N
ELIZABETH
RIVER
of the
BRANCH
SOUTHERN
WETSLIP No. 1
DD 1
DD No. 2
DD No. 3
DD No. 4
PIER 3
PIER 4
PIER 5
PIER 6
DRYDOCK No. 8
DISPOSAL YARD
Norfolk Naval Shipyard Southgate Annex
PIER A
PIER B
PIER C
PIER D
PIER E
LEGEND
●₅ SEDIMENT SAMPLE POINT
▲₅ WATER SAMPLE POINT
●₂ PERIMETER DOSIMETRY LOCATION
INDUSTRIAL SECURITY FENCE
SHIPYARD PERIMETER FENCE

FIGURE 22

FIGURE 23


HAMPTON ROADS HARBOR
Pier 12
Pier 10
Pier 7
Pier 5
Pier 4
Pier 3
Pier 2
Pier 25
Pier 24
Pier 23
Pier 22
Pier 21
Pier 20
MUNICIPAL TERMINALS
N
Norfolk Naval Station
Norfolk, Virginia
scale in feet
400 0 400 1200 2000
Adm Taussig Blvd
Hampton Blvd
LEGEND
● SEDIMENT SAMPLE POINT
▲ WATER SAMPLE POINT
■ PERIMETER DOSIMETRY DEVICE

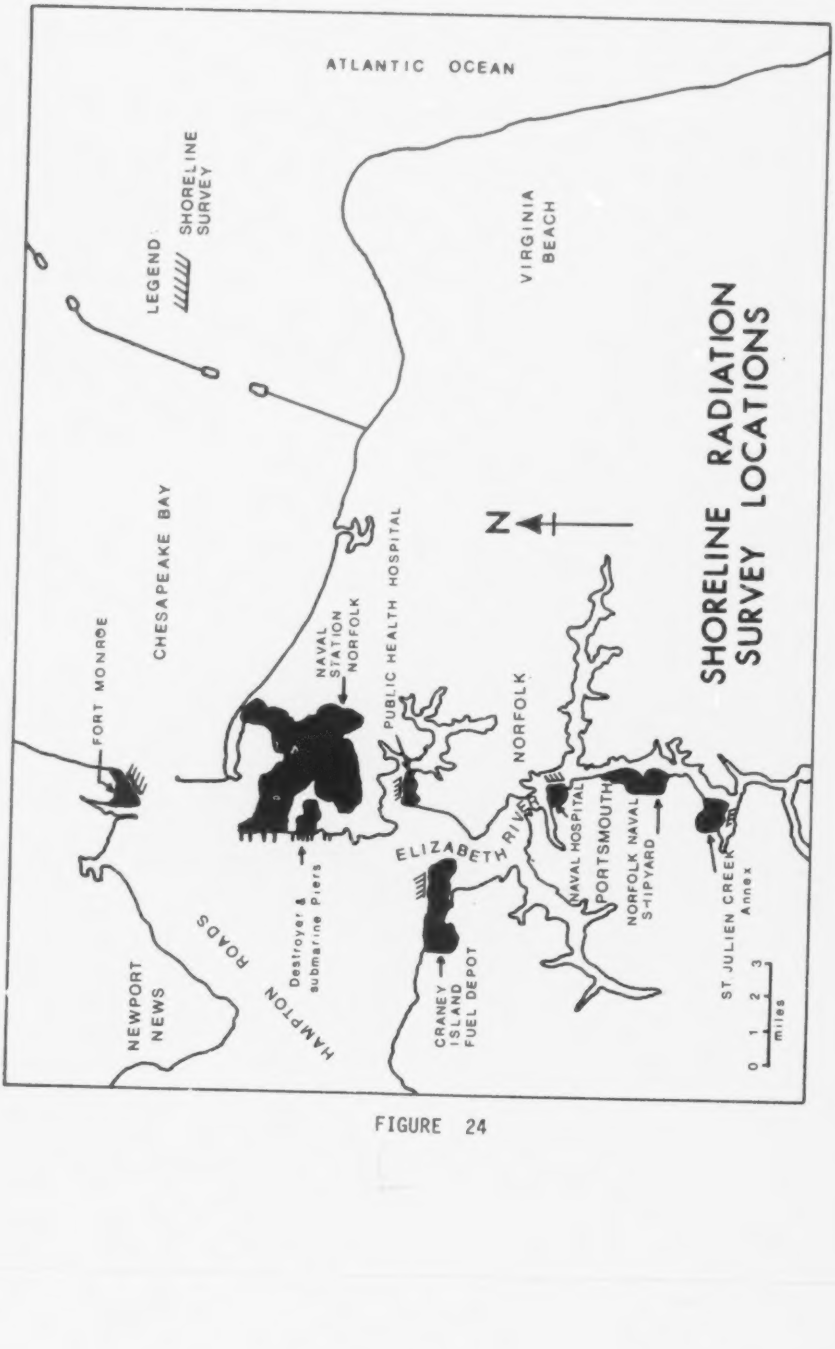
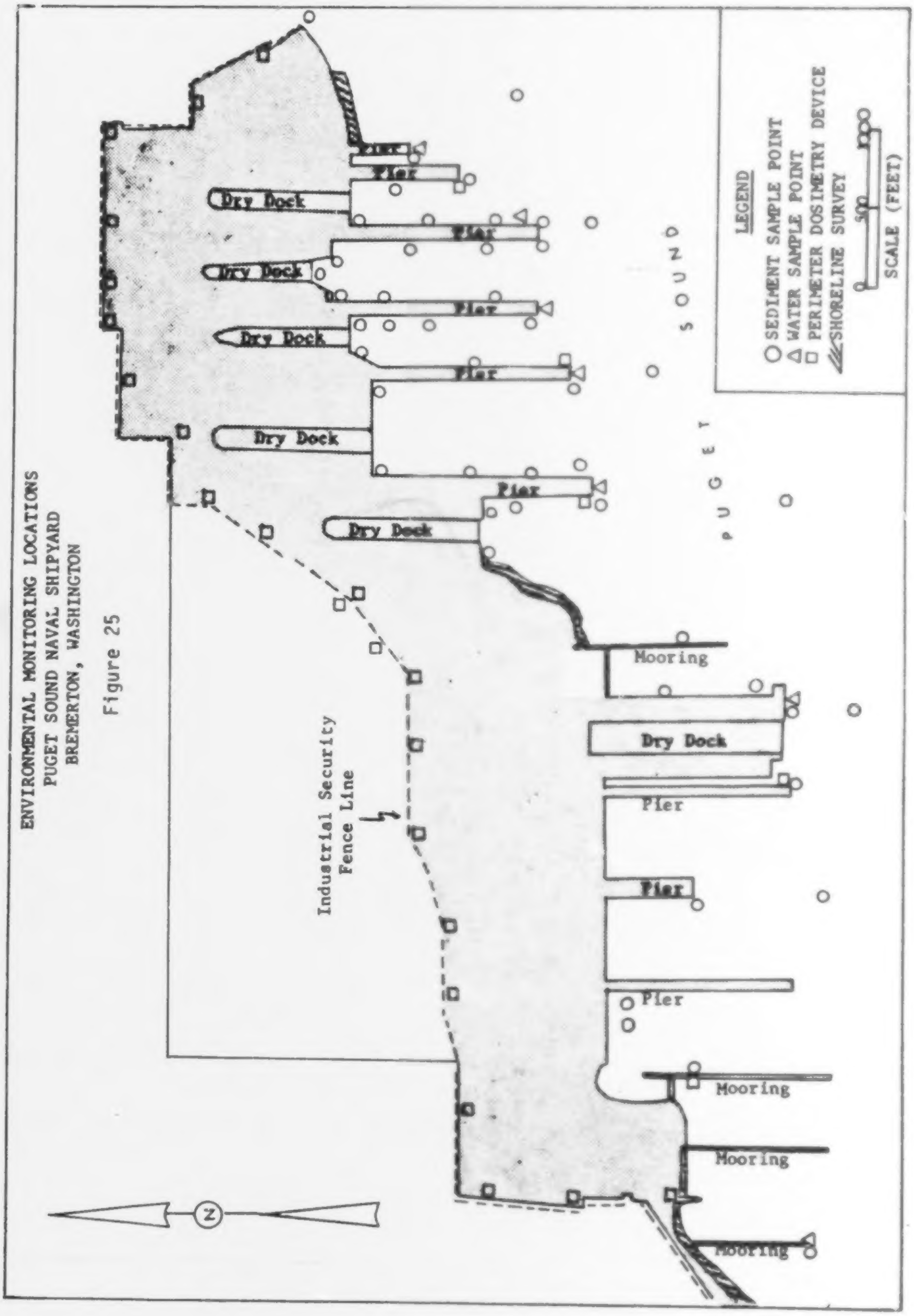

ATLANTIC OCEAN
LEGEND
SHORELINE SURVEY
VIRGINIA BEACH
CHESAPEAKE BAY
FORT MONROE
NAVAL STATION NORFOLK
PUBLIC HEALTH HOSPITAL
N
NORFOLK
NEWPORT NEWS
HAMPTON ROADS
Destroyer & submarine Piers
ELIZABETH RIVER
CRANEY ISLAND FUEL DEPOT
NAVAL HOSPITAL
PORTSMOUTH
NORFOLK NAVAL SHIPYARD
ST JULIEN CREEK Annex
0 1 2 3
miles
SHORELINE RADIATION SURVEY LOCATIONS

FIGURE 24


Pier
Dry Dock
Mooring
Industrial Security Fence Line
PUGET SOUND
LEGEND
SEDIMENT SAMPLE POINT
WATER SAMPLE POINT
PERIMETER DOSIMETRY DEVICE
SHORELINE SURVEY
500
SCALE (FEET)
N

ENVIRONMENTAL MONITORING LOCATIONS
PUGET SOUND NAVAL SHIPYARD
BREMERTON, WASHINGTON

Figure 25

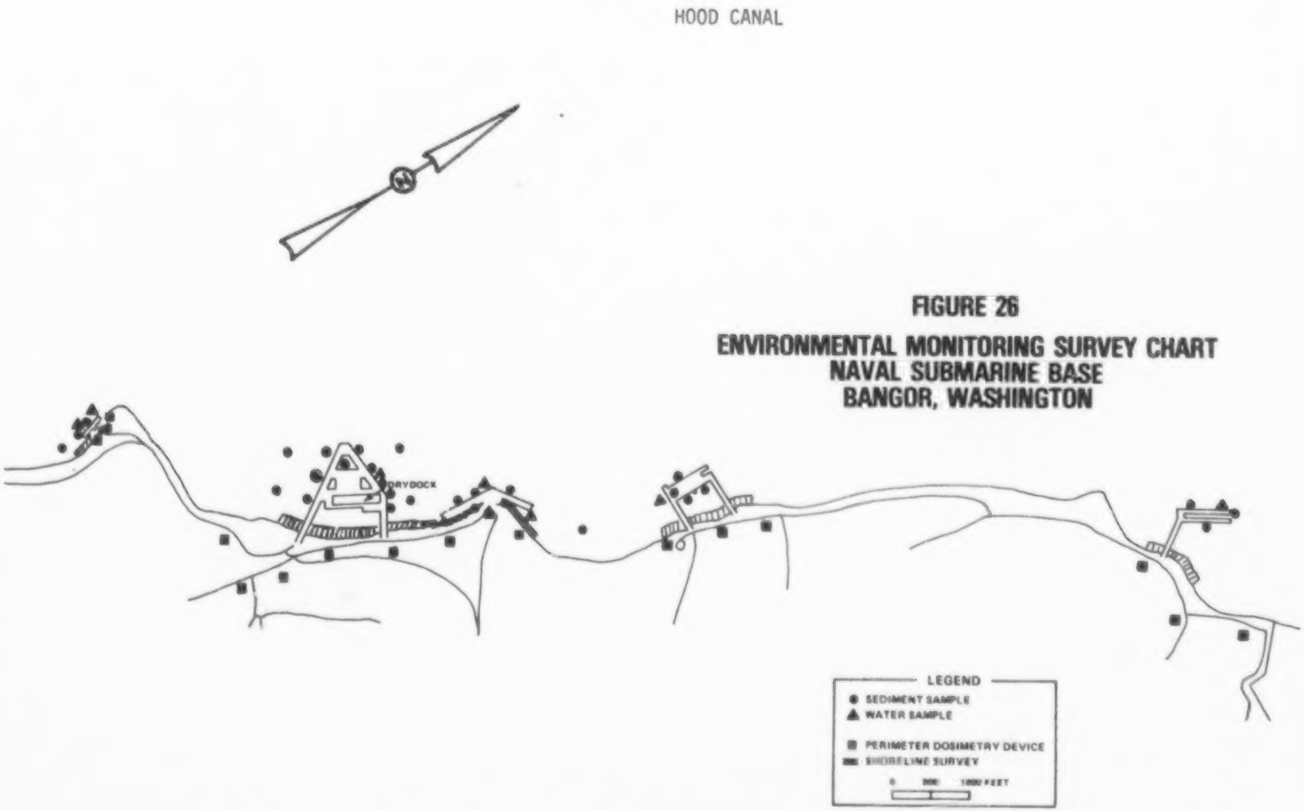

HOOD CANAL
DRYDOCK
LEGEND
● SEDIMENT SAMPLE
▲ WATER SAMPLE
■ PERIMETER DOSIMETRY DEVICE
▬ SHORELINE SURVEY
0 500 1000 FEET

FIGURE 26

ENVIRONMENTAL MONITORING SURVEY CHART
NAVAL SUBMARINE BASE
BANGOR, WASHINGTON

Attachment II

Report NT-81-2
February 1981

OCCUPATIONAL RADIATION EXPOSURE
FROM U. S. NAVAL NUCLEAR PROPULSION PLANTS
AND THEIR SUPPORT FACILITIES
1980

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TABLE OF CONTENTS

SUMMARY 1

EXTERNAL RADIATION EXPOSURE 3

- Policy and Limits. 3
- Source of Radiation. 4
- Control of Radiation During Reactor Plant Operation. 5
- Control of Radiation in Support Facilities 6
- Dosimetry. 6
- Physical Examinations. 9
- Shipyard Training. 10
- Nuclear Power Training 13
- Radiation Exposure Reduction 14
- Radiation Exposure Data. 16

INTERNAL RADIOACTIVITY. 25

- Policy and Limits. 25
- Source of Radioactivity. 25
- Control of Airborne Radioactivity. 26
- Control of Radioactive Surface Contamination 27
- Control of Food and Water. 27
- Wounds 28
- Monitoring for Internal Radioactivity. 28
- Results of Internal Monitoring in 1980 29

EFFECTS OF RADIATION ON PERSONNEL 30

- Exposure to Radiation Involves Some Risk 30
- Studies of the Effects of Radiation on Humans 30
- Numerical Estimates of Risk from Radiation 33
- Radiation Exposure Comparisons 34
- Extrapolations 37
- Conclusions on the Effects of Radiation on Personnel 37

CLAIMS FOR RADIATION INJURY TO PERSONNEL. 39

AUDITS AND REVIEWS. 41

ABNORMAL OCCURRENCES. 42

REFERENCES. 44

LIST OF FIGURES

FIGURE 1 TOTAL RADIATION RECEIVED BY MILITARY AND CIVILIAN PERSONNEL IN THE NAVAL NUCLEAR PROPULSION PROGRAM 1960-1980 2

FIGURE 2 TOTAL RADIATION EXPOSURE RECEIVED BY SHIPYARD PERSONNEL FROM WORK ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS 1958-1980 21

LIST OF TABLES

TABLE 1 SHIPYARD FIRST REACTOR PLANT OPERATION AND FIRST RADIOACTIVE OVERHAUL WORK 18

TABLE 2 OCCUPATIONAL RADIATION EXPOSURE RECEIVED BY PERSONNEL ASSIGNED TO TENDERS, BASES, AND NUCLEAR-POWERED SHIPS FROM OPERATION AND MAINTENANCE OF NAVAL NUCLEAR PROPULSION PLANTS 19

TABLE 3 OCCUPATIONAL RADIATION EXPOSURE RECEIVED BY SHIPYARD PERSONNEL FROM WORK ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS 20

TABLE 4 SHIPYARD AND FLEET DISTRIBUTION OF PERSONNEL RADIATION EXPOSURE. 22

TABLE 5 DISTRIBUTION OF TOTAL LIFETIME OCCUPATIONAL RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS. 23

TABLE 6 PERSONNEL RADIATION EXPOSURE FOR COMMERCIAL NUCLEAR POWER REACTORS LICENSED BY U. S. NUCLEAR REGULATORY COMMISSION. 24

TABLE 7 CLAIMS FOR RADIATION INJURY TO PERSONNEL. 40

TABLE 8 ABNORMAL OCCURRENCES IN THE NAVAL NUCLEAR PROPULSION PROGRAM 43

SUMMARY

Radiation exposures to Navy and civilian personnel monitored for radiation associated with U. S. Naval nuclear propulsion plants are summarized in this report. Navy personnel manned fourteen tenders, two submarine bases, 114 nuclear-powered submarines and twelve nuclear-powered surface ships which were in operation at the end of 1980. Nine shipyards were engaged in construction, overhaul, and refueling of these ships. The benefits of nuclear propulsion in our most capable combatant ships have long been recognized, and our nuclear-powered ballistic missile submarines form the most invulnerable element of the United States strategic deterrence.

Figure 1 shows that the total radiation exposure has been reduced to about one sixth of the amount in the peak year of 1966, even though the number of nuclear-powered ships nearly doubled during that period. Total man-rem in this figure is the sum of the annual exposures of each person monitored for radiation.

No civilian or military personnel in the Naval nuclear propulsion program have exceeded the Federal limit which allows five rem exposure for each year of age beyond age eighteen. Since 1967 no person has exceeded the Federal limit which allows up to three rem per quarter year, nor in this period has anyone exceeded the Navy's self-imposed limit of 5 rem per year for radiation associated with Naval nuclear propulsion plants.

No civilian or military personnel in the Naval nuclear propulsion program have ever received more than one tenth the Federal annual occupational exposure limit from internal radiation exposure caused by radioactivity associated with Naval nuclear propulsion plants.

The average occupational exposure of each person monitored has been about one quarter rem per year. The total lifetime exposure from radiation associated with Naval nuclear propulsion plants to date for all personnel monitored since 1954 has averaged about one rem per person.

According to the standard methods for estimating risk, the risk to the group of personnel occupationally exposed to radiation associated with Naval nuclear propulsion plants is less than the risk these same personnel have from exposure to natural background radiation or to medical radiation. This risk is small compared to the risks accepted in normal industrial activities, and it is small compared to the risks regularly accepted in daily life outside work.

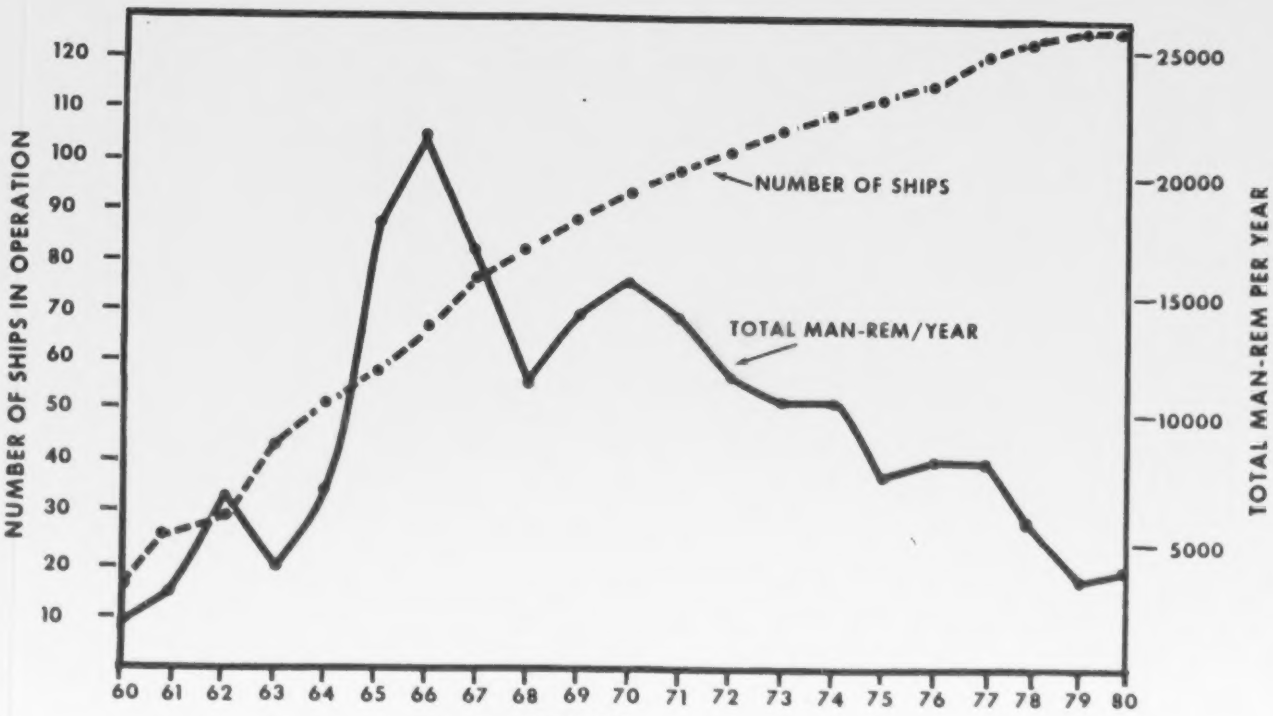

FIGURE 1

TOTAL RADIATION EXPOSURE RECEIVED BY MILITARY AND CIVILIAN PERSONNEL IN THE NAVAL NUCLEAR PROPULSION PROGRAM 1960 - 1980

EXTERNAL RADIATION EXPOSURE

Policy and Limits

The policy of the U. S. Navy is to reduce as low as reasonably achievable, exposure to personnel from ionizing radiation associated with Naval nuclear propulsion plants.

The radiation exposure limits used in the U. S. and abroad for whole body radiation exposure are 3 rem per quarter year and 5 rem accumulated dose for each year beyond age eighteen. These limits were recommended in 1958 by the U. S. National Committee ("Committee" was changed to "Council" when the organization was chartered by the U. S. Congress in 1964) on Radiation Protection and Measurements (ref 1) and by the International Commission on Radiological Protection (ref 2). They were adopted by the U. S. Atomic Energy Commission (AEC) and applied both within the AEC and to licensees in 1959 (ref 3). The U. S. Federal Radiation Council recommendation that these be used as guidance for Federal agencies was approved by President Eisenhower May 13, 1960 (ref 4). The U. S. Department of Labor adopted these same limits. A key part of each of these standards has been emphasis on minimizing radiation exposure to personnel.

In 1965 the International Commission on Radiological Protection (ref 5) reiterated the quarterly and accumulated limits cited above but suggested that exceeding 5 rem in one year should be infrequent. Although none of the other organizations referred to above changed its recommendations accordingly, the Naval nuclear propulsion program adopted 5 rem per year as a rigorous limit effective in 1967.

In 1971 the National Council on Radiation Protection and Measurements (ref 6) recommended that 5 rem be adopted as the annual limit under most conditions. In 1974 the Atomic Energy Commission (now Department of Energy) (ref 7) established 5 rem as its annual limit. In 1977 the International Commission on Radiological Protection (ref 8) deleted the accumulated limit and recommended 5 rem as the annual limit. In 1979 the Nuclear Regulatory Commission issued a proposed change to the Code of Federal Regulations Title 10, Part 20 to require its licensees to use 5 rem as an annual limit. In January 1981, the Environmental Protection Agency recommended that Federal agencies use 5 rem as an annual limit (ref 9).

The Navy limits for the nuclear propulsion program since 1967 have been:

3 rem per quarter year
5 rem per year

References are listed on pages 44 and 45.

Special limits are in effect such as for hands and feet; however, there have been few cases where these limits have been more restrictive than the whole body radiation exposure limits. Therefore, the radiation exposures discussed in this report are nearly all from whole body radiation. Controls are also in effect to minimize any occupational radiation exposure to the unborn child of a pregnant worker.

Each organization in the Navy nuclear propulsion program is required to have an active program to reduce radiation exposure to the minimum practicable.

Source of Radiation

The radiation discussed in this report originates from pressurized water reactors. Water circulates through a closed piping system to transfer heat from the reactor core to a secondary steam system isolated from the reactor cooling water. Trace amounts of corrosion and wear products are carried by reactor coolant from reactor plant metal surfaces. Some of these corrosion and wear products are deposited on the reactor core and become radioactive from exposure to neutrons. Reactor coolant carries some of these radioactive products through the piping systems where a portion of the radioactivity is removed by a purification system. Most of the remaining radionuclides transported from the reactor core deposit in the piping systems.

The reactor core is installed in a heavy-walled pressure vessel within a primary shield. This shield limits radiation exposure from the gammas and neutrons produced when the reactor is at power. Reactor plant piping systems are installed primarily inside a reactor compartment which is surrounded by a secondary shield. Access to the reactor compartment is permitted only after the reactor is shut down. Most radiation exposure to personnel comes from inspection, maintenance and repair inside the reactor compartment. The major source of this radiation is cobalt 60 deposited inside the piping systems. Cobalt 60 emits two high energy gammas and a low energy beta for every radioactive decay. Its half-life is 5.3 years.

Neutrons produced when reactor fuel fissions are shielded by both primary and secondary shields before penetrating to occupied areas. Radiation exposure to personnel from these neutrons during reactor operation has been much less than from gammas. After reactor shutdown, when shipyard and other support facility work is done, no neutron exposure is detectable. As a result, the radiation exposures discussed in this report are nearly all from gamma radiation.

Control of Radiation During Reactor Plant Operation

Reactor plant shielding is designed to minimize radiation exposure to personnel. Shield design criteria establishing radiation levels in various parts of each nuclear-powered ship are personally approved by the Deputy Commander for Nuclear Propulsion, Naval Sea Systems Command.

Ship design is also controlled to keep locations, such as duty stations where personnel need to spend time, as far as practicable away from the reactor compartment shield. Special attention is paid to living quarters. For example, the shield design criteria were established such that a person would have to spend more than 48 hours per day in living quarters to exceed exposure limits (which is impossible since there are only 24 hours in a day).

Resulting radiation exposure to those aboard ship outside propulsion plant spaces during reactor plant operation is not any greater than natural background radiation. For submarine operating personnel outside the propulsion plant, the combination of low natural radioactivity in ship construction materials and reduced cosmic radiation under water provides less radiation exposure at sea than the public receives ashore. Those who operate the nuclear propulsion plant receive more radiation exposure in port during maintenance and overhaul periods than they receive from operating the propulsion plant at sea.

Control of Radiation in Support Facilities

Tenders for nuclear-powered submarines and surface ships are designed so that radioactive material is handled only in specially designed and shielded nuclear support facilities. Submarine bases and shipyards limit to the minimum, the number of places where radioactive material is allowed. Specific traffic routes are required to be used for any movement of radioactive material outside these nuclear support facilities. A radioactive material accountability system is used to ensure no radioactive material is lost or misplaced in a location where personnel could unknowingly be exposed. Regular inventories are required for every item in the radioactive material accountability system. Radioactive material is tagged with yellow and magenta tags bearing the standard radiation symbol and the measured radiation level. Radioactive material removed from a reactor plant is required to be placed in yellow plastic, and the use of yellow plastic is reserved solely for radioactive material. All personnel assigned to a tender, submarine base or shipyard are trained to recognize that yellow plastic identifies radioactive material and to initiate immediate action if radioactive material is discovered out of place.

Access to radiation areas is controlled by radiological control personnel. Personnel are required to wear dosimetry devices to enter these areas. Dosimetry devices are also posted outside these areas to verify that personnel outside these areas do not require monitoring. Frequent radiation surveys are required using instruments which are checked before use and calibrated regularly. Areas where radiation levels are greater than 0.1 rem per hour are called high radiation areas and are locked or guarded.

Dosimetry

Thermoluminescent dosimeters (TLDs) are the dosimetry devices worn by personnel to measure their exposure to gamma radiation. The thermoluminescent dosimeter contains two chips of calcium fluoride with added manganese. It is characteristic of thermoluminescent material that radiation causes internal changes which make the material, when subsequently heated, give off an amount of light directly proportional to the radiation dose. In order to make it convenient to handle, these chips of calcium fluoride are in contact with a metallic heating strip with heater wires extending through the ends of a surrounding glass envelope. The glass bulb is protected by a plastic case designed to permit the proper response to gammas of various energies. Gammas of such low energy that they will not penetrate the plastic case constitute less than a few percent of the total gamma radiation present. To read the radiation exposure, a trained operator removes the glass bulb and places it in a TLD reader so that the metal heater wires contact an electrical circuit. An electronically controlled device heats the calcium fluoride chips to several hundred degrees centigrade in a timed cycle, and the intensity of light emitted is measured and converted to a digital readout in units of rem. The heating cycle also anneals the calcium fluoride chips so that the dosimeter is zeroed and ready for subsequent use. The entire cycle of reading a TLD described here takes about thirty seconds. This rapid readout capability was one reason for changing from film badges to TLDs. The use of TLDs permits more frequent measurement of a worker's radiation exposure than film badges.

TLDs are required to be processed at least daily in Naval shipyards. Aboard ship TLDs are required to be processed at least monthly except that daily processing is required for anyone entering a reactor compartment or high radiation area. To ensure accuracy, a number of calibration checks are performed on the TLD system. For example, each TLD is checked every six months for response within fifteen percent of a known exposure. Also each TLD reader must check within one percent against its internal calibration standard prior to each use and at least hourly when the reader is in use.

Pocket ionization chambers with an eyepiece permit the wearer to read his own radiation exposure. This pocket dosimeter is required in addition to a TLD when entering a reactor compartment or a high radiation area. Pocket dosimeters are used to enable the wearer to keep track of his own radiation exposure during a work period. The official record of radiation exposure is obtained from the TLD.

Dosimetry devices are worn on the trunk of the body, normally at the waist or chest, whichever will receive the higher exposure. In some special situations dosimeters are worn at other locations, for example on the hands or fingers or head.

Prior to 1974 film badges were used to measure radiation exposure. Film packets like those used for dental X-ray were placed in holders designed to allow differentiating between types of radiation. The darkness of the processed film was measured with a densitometer and converted to units of radiation exposure. When the first personnel radiation exposures were measured in the Naval Nuclear Propulsion Program there already was widespread photodosimetry experience in the Navy and precise procedures existed to provide reproducible results.

Each film badge was clearly marked with a name or number corresponding to the individual to whom it was assigned. This number was periodically checked by a radiological control technician before a worker entered a high radiation area. In high radiation areas every worker also wore a pocket dosimeter which was read by radiological control personnel when the worker left the area. At the end of each month when the film badges were processed, the film badge measurements were compared with the sum of the pocket dosimeters readings. The film badge results were, with few exceptions, entered in the permanent personnel radiation exposure records.

Discrepancies between film badge and pocket dosimeter measurements were investigated. These investigations included making independent estimates of the worker's exposure using such methods as time spent in the specific radiation area and comparing the estimates with the two measurements to determine which measurement was in error. If the error could not be determined, then the higher exposure was recorded for the worker. In nearly all cases this was the film badge measurement.

Results of numerous tests conducted by shipyards under the same conditions that most radiation exposure was received showed that film measurements averaged fifteen percent higher than actual radiation exposures. This was a conscious conservatism to ensure that under the worst case, the film measurement was not less than the actual radiation exposure. Film response varies with the energy of the gamma radiation. The calibration of the film was performed at high energy where the film has the least response to radiation exposure. Radiation of lower energies corresponding to scattered radiation from shielded cobalt 60 causes the film to indicate more radiation exposure than is present.

Data gathered in over 20 years of neutron monitoring aboard ship using neutron film badges demonstrated that the monitored individuals did not receive neutron exposure above the minimum detection level for neutron film. Naval nuclear-powered ships and their support facilities now use lithium fluoride TLDs to monitor neutron exposure of the few workers exposed to neutron sources used for radiation instrument calibration and for reactor plant instrumentation. These measured neutron exposures have been added to gamma exposures in the total whole body radiation exposure in this report, but because neutron exposures are so low, the radiation exposures in this report are nearly all from gamma radiation.

Monitoring for beta radiation is not normally required because betas cannot penetrate the metal boundaries of the reactor coolant system. Beta radiation needs to be considered in maintenance or repair operations only when systems are opened so that personnel are close to surfaces which have been contaminated with radioactive corrosion products from reactor coolant. In these cases normal clothing or eyeglasses or plastic contamination control materials completely shield beta radiation of the energies normally present. Support facilities routinely provide such shielding to eliminate personnel radiation exposure from betas.

Monitoring for alpha radiation is not a normal part of operation or maintenance of Naval nuclear propulsion plants. However, alpha monitoring is sometimes necessary to identify radium daughter products naturally present in the atmosphere.

Physical Examinations

Radiation medical examinations have been required since the beginning of the Naval nuclear propulsion program for personnel exposed to radiation. In these examinations the doctor pays special attention to any condition which might indicate that radiation exposure would cause an increased degree of risk. Passing this examination is a prerequisite for obtaining the dosimetry badge which permits entry to areas where radiation exposure can be received. For military personnel who have already been screened by physical examinations, few fail this radiation medical examination. For civilian shipyard workers, the failure rate is a few percent. However, failure of this examination does not mean a shipyard worker will not have a job. Since shipyard workers spend most of their time on nonradioactive work, inability to qualify for radioactive work does not restrict their job opportunities. No shipyard worker in the Naval nuclear propulsion program has been fired for inability to pass a radiation medical examination.

Radiation medical examinations are given prior to initial radiation work and at termination of radiation work in the nuclear propulsion program (or at termination of employment) if the worker has received more than 0.5 rem in any year. In addition, during each three year period anyone who has received more than 0.5 rem in one year receives a radiation medical examination. The basis for selecting 0.5 rem as a criterion for examination is that those who receive less than 0.5 rem in a year have not exceeded radiation exposures permitted by Federal regulations for members of the general population.

A radiation medical examination includes review of medical history to determine, among other subjects, past radiation exposure, history of cancer, history of radiation therapy, and family history of cancer. In the medical examination particular attention is paid to evidence of cancer as well as cataracts in the eyes. Laboratory procedures include urinalysis, blood analysis, and comparison of blood constituents to a specific set of standards. Chest X-rays with full size film to reduce radiation exposure were also a routine part of all radiation medical examinations until 1977. At that time routine chest X-rays were discontinued, further reducing radiation exposure of workers. Chest X-rays are now performed when clinically indicated at the discretion of the medical officer. In the event disqualifying conditions are found in an examination of Naval civilian or military personnel, the individual is barred from receiving occupational radiation exposure until the results of the examination are reviewed by the Bureau of Medicine and Surgery Radiation Effects Advisory Board. Only after approval of the board would the individual be permitted to receive occupational radiation exposure.

Shipyard Training:

Periodic radiological control training is performed to ensure each person understands the general and specific radiological aspects which he might encounter, understands his responsibility to the Navy and the public for safe handling of radioactive materials, understands the risks associated with radiation exposure and understands his responsibility to minimize his own radiation exposure. Training is also provided on the biological risk of radiation exposure to the unborn child. Prior to being authorized to perform radiation work, an employee is required to complete satisfactorily a radiological control training course, including a written examination. Typical course lengths for workers range from 16 to 32 hours. In written examinations on radiological controls short answer questions, such as multiple choice and true-false questions, are not normally used. Following are the minimum training requirements for workers:

1. Radiation Exposure Control

    a. State the limits for whole body penetrating radiation. Explain that the rem is a unit of biological dose from radiation.

    b. Explain how "stay times" are used.

    c. Be aware of the seriousness of violating instructions on radiation warning signs and unauthorized passage through barriers; be aware of penalties for violating these requirements.

    d. Discuss procedures and methods for minimizing exposure such as working at a distance from a source, reducing time in a radiation area, and shielding.

    e. Discuss potential sources of radiation associated with work performed by the individual's trade.

    f. State where dosimetry equipment shall be placed on an individual's body.

    g. Demonstrate ability to read all types of dosimeters in use.

    h. Discuss importance of the individual keeping track of his own exposure.

    i. Be aware of the significance of personnel radiation exposure. The National Council on Radiation Protection and Measurements has stated that while exposures of workers and the general population should be kept to the lowest practicable level at all times, the presently permitted exposures represent a level of risk small compared with other hazards of life. The Nuclear Regulatory Commission has stated, "Control of exposure to radiation is based on the assumption that any exposure, no matter how small, involves some risk." The risk of injury from radiation associated with Naval nuclear propulsion plants is low compared to the occupational and nonoccupational risks accepted in everyday life.

2. Contamination Control

   a. Discuss how contamination is controlled during radioactive work (e.g., containment in plastic bags and use of contamination containment areas).

   b. Discuss procedures for preventing contamination of personnel and how contamination is detected on personnel.

   c. Discuss how contamination is removed from contaminated objects and personnel.

   d. Discuss potential sources of contamination associated with work performed by the individual's trade.

   e. State the beta-gamma surface contamination limit. Discuss the meaning of the units of the limit.

   f. Demonstrate proper procedure for donning and removing a full set of anticontamination clothing.

   g. Demonstrate proper procedures for entering and leaving a contaminated area including proper procedures for self-monitoring.

   h. Explain what radioactive contamination is. Explain the difference between radiation and radioactive contamination.

   i. For personnel required to work in containment areas (e.g., glove bags or tents), demonstrate proper procedures for working in these areas. (This ability is often demonstrated on a mock-up.)

   j. For personnel who are likely to encounter airborne radioactivity, demonstrate the proper procedure for donning and removing the type of respiratory equipment the individual will be required to wear. For personnel who are required to wear respiratory equipment with anticontamination clothing, this demonstration shall be performed when donning and removing anticontamination clothing. The demonstration shall include any leak checks required to be made to test for proper operation of respiratory equipment.

k. For personnel who are likely to encounter airborne radioactivity, state the conditions which require wearing masks, air supplied respirators, or air supplied hoods.

3. Accountability of Radioactive Materials - Know that radioactive materials are accounted for when transferred between radiologically controlled areas by tagging, by recording dispostion of material, and by specific authorization of radiological control personnel.

4. Waste Disposal - Discuss how the individual workers can reduce the amount of radioactive liquid and solid waste.

5. Radiological Incidents

   a. Discuss the need for consulting radiological control personnel when questions or incidents occur.

   b. Discuss procedures to be followed after a spill of material (liquid or solid) which is or might be radioactive.

   c. Discuss procedures to be followed when notified that airborne radioactivity is above the limit.

   d. Demonstrate the action to be taken in event of a spill of radioactive liquid. This ability shall be demonstrated during a drill.

   e. Discuss the action to be taken when an individual discovers his dosimeter is off-scale.

6. Responsibilities of Individuals - Discuss actions required in order to fulfill workers' responsibilities. Include the responsibility of the individual to inform his employer of previous or concurrent occupational radiation exposure received.

In addition to passing a written examination, completion of this training course requires satisfactory performance during basic types of simulated work operations. For an employee to continue as a radiation worker he has to requalify in a manner similar to the initial qualification at least every two years. In between these qualification periods personnel are required to be selected at random for additional examination to determine how well the knowledge has been retained. Training is also conducted by individual shop instructors in the specific job skills for radiation work within each trade. For complex jobs this is followed by special training for the specific job, frequently using mock-ups outside radiation areas.

Radiological control technicians are required to complete a course of about six months in radiological controls, to demonstrate their practical abilities, and to pass comprehensive written and oral examinations. Radiological control supervisors are required to have at least the same technical knowledge and abilities as the technicians; however, passing scores for supervisors' examinations are higher or supervisors' examinations are more difficult than for technicians. Oral examinations are conducted by senior radiological control managers and require personnel to be able to evaluate symptoms of unusual radiological control situations. The radiological control technician or supervisor is required to evaluate initial symptoms, state immediate corrective action required, state what additional measurements are required, and do a final analysis of the measurements to identify the specific problem. Subsequent to qualification, periodic training sessions are required in which each radiological control technician and supervisor demonstrates ability to handle situations such as are used in the oral examinations. At least every two years radiological control personnel have to requalify through written and oral examinations similar to those used for initial qualification. Radiological control technicians and supervisors are required to demonstrate their practical abilities frequently through unannounced drills.

In addition to the above training for those who are involved in radioactive work, each shipyard employee not involved in radioactive work and each person assigned to a nuclear-powered ship or a support facility is required to receive basic radiological training which is repeated at least annually. This training is to ensure personnel understand the posting of radiation areas, the identification of radioactive materials, and not to cross radiation barriers. This instruction also explains that the radiation environment of personnel outside radiation areas and outside the ship or shipyard is not significantly affected by nuclear propulsion plant work.

Nuclear Power Training

Military personnel who operate Naval nuclear propulsion plants are required to pass a six month basic training course at nuclear power school and a six month qualification course at a land-based prototype of a shipboard reactor plant. Each nuclear-trained officer and enlisted man receives extensive radiological control training including lectures, demonstrations, practical work, radiological control drills and written and oral examinations. This training has emphasized the ability to apply basic information on radiation and radioactivity.

Those enlisted personnel who will have additional responsibilities for radiological control are designated Engineering Laboratory Technicians and receive an additional three months training after completion of the one year program.

Prior to becoming qualified as the Engineer Officer, that is, the head of the engineering department of a nuclear-powered ship, a nuclear-trained officer must pass a one day written examination and a sequence of oral examinations conducted at Naval Reactors headquarters. A key part of these qualification examinations is radiological controls.

Immediately before serving as Commanding Officer of a nuclear-powered ship, an officer attends a three month course at Naval Reactors headquarters. The radiological controls portion of this is an advanced course and assumes the officer starts with detailed familiarity with shipboard radiological controls. The officer must pass both written and oral examinations in radiological controls during this course prior to assuming command of a nuclear-powered ship.

Radiation Exposure Reduction

Maintaining personnel radiation exposures as low as reasonably achievable involves all levels of management in nuclear-powered ships and their support facilities. Operations, maintenance and repair personnel are required to be involved in this subject; it is not left solely to radiological control personnel. To evaluate the effectiveness of radiation exposure reduction programs, managers use a set of goals. Goals are also set in advance to keep each worker's exposure under certain levels and to minimize the number of workers involved. Goals are also set on the total cumulative personnel radiation exposure (man-rem) for each major job, for the entire overhaul or maintenance period, and for the whole year. These goals are deliberately made hard to meet in order to encourage personnel to improve performance.

Of the various goals used, the most effective in reducing personnel radiation exposure has been the use of radiation control levels which are lower than the Navy's quarterly and annual limits. Control levels in shipyards range from 0.5 rem to 2 rem for the year, depending on the amount of radioactive work scheduled, whereas 5 rem per year is the Navy limit.

To achieve the benefits of lower control levels in reducing total man-rem, it is essential to minimize the number of workers permitted to receive radiation exposure. Otherwise the control levels could be met merely by adding more workers. Organizations are required to conduct periodic reviews to ensure the number of workers is the minimum.

Following is a brief checklist which has been in use for years in maintaining personnel radiation exposure as low as reasonably achievable during maintenance, overhaul, and repair.

Preliminary Planning

- Plan in advance
- Delete unnecessary work
- Determine expected radiation levels

Preparation of Work Procedures

- Plan access to and exit from work area
- Provide for service lines (air, welding, ventilation, etc.)
- Provide communication (sometimes includes closed-circuit television)
- Remove sources of radiation
- Plan for installation of temporary shielding
- Decontaminate
- Work in lowest radiation levels
- Perform as much work as practicable outside radiation areas
- State requirements for standard tools
- Consider special tools
- Include inspection requirements (these identify steps where radiological control personnel must sign prior to work proceeding)
- Minimize discomfort of workers
- Estimate man-rem

Temporary Shielding

- Control installation and removal by written procedure
- Inspect after installation
- Conduct periodic radiation surveys
- Minimize damage caused by heavy lead temporary shielding
- Prohibit use of lead shot for temporary shielding
- Balance radiation exposure received in installation against exposure to be saved by installation
- Shield travel routes
- Shield components with abnormally high radiation levels early in the maintenance period
- Shield position worker occupies
- Perform directional surveys to improve design of shielding by locating sources of radiation
- Use mock-up to plan temporary shielding design and installation

Rehearsing and Briefing

- Rehearse
- Use mock-up duplicating working conditions
- Use photographs
- Brief workers

Performing Work

- Post radiation levels
- Keep excess personnel out of radiation areas
- Minimize beta radiation exposure (anticontamination clothing effectively shields cobalt 60 betas)
- Supervisors and workers keep track of radiation exposure
- Workers assist in radiation and radioactivity measurements

- Delegate radiological control monitoring responsibilities when necessary to minimize radiation exposure
- Evaluate use of fewer workers
- Reevaluate reducing radiation exposures

Radiation Exposure Data

Radioactive materials had been handled in shipyards for years before Naval nuclear propulsion plant work started. Examples of such work include non-destructive testing using radiography sources and radiation instrument calibration using radioactive sources. Since this work is licensed by the Nuclear Regulatory Commission or by a state under agreement with the Nuclear Regulatory Commission, the radiation exposure from this licensed work has been excluded whenever practicable from this report.

Table 1 shows the dates when radioactive work associated with Naval nuclear propulsion plants started in each of eleven shipyards. Seven of these shipyards have constructed Naval nuclear-powered ships; however, little radiation exposure is received in new construction. The dates of starting reactor plant overhaul, therefore, are the significant dates for start of radioactive work.

Table 2 summarizes radiation exposure received in nuclear-powered ships and their supporting tenders and submarine bases since the first nuclear-powered ship went to sea in January 1955. Most of the radiation exposure in this table results from inspection, maintenance and repair work in the reactor compartments of ships. Radiation exposures for reactor compartment work increase as reactor plant radiation levels increase with the age of the plant.

As expected, the number of personnel monitored for exposure to radiation increased with the increasing number of nuclear-powered ships. Initially everyone aboard a nuclear-powered submarine was monitored for radiation exposure. After years of experience showed that personnel outside propulsion plant spaces received exposures indistinguishable from natural background, the number of personnel monitored for occupational exposure to radiation was sharply reduced in 1974. For example, in 1973 almost sixty percent of those monitored were recorded as receiving zero radiation exposure; as a result of reducing numbers of personnel monitored unnecessarily, less than ten percent are now recorded with zero exposure. Personnel outside propulsion plant spaces in submarines now wear dosimetry badges to verify they receive no occupational exposure.

Table 3 summarizes radiation exposures of shipyard personnel since the start of Naval nuclear propulsion plant radioactive work in 1954. Figure 2 shows graphically that total personnel radiation exposure has been reduced in shipyards even though the amount of work has increased. Since ship overhauls frequently overlapped calendar years, the numbers of ships in overhaul shown in Figure 2 were determined by dividing by 12 the total number of months each ship was in overhaul during a calendar year.

The increase in the numbers of personnel monitored and total man-rem exposure in the early years shows the increasing workload in reactor plant work as the number of ships was increased. By 1962 four submarine reactor plants had been overhauled and major efforts were underway to reduce radiation levels. By 1966 the number of ships in overhaul had quadrupled as indicated by the buildup to the peak in total man-rem. Subsequently, the number of ships in overhaul more than doubled again. Decreases in total annual exposures, numbers of personnel monitored, and numbers of personnel with annual exposures over 2 rem have been results of the program to reduce radiation exposures to the minimum practicable. The total annual exposure for the shipyards has averaged less than 6000 man-rem and for ships has averaged less than 2000 man-rem.

Since a worker usually is exposed to radiation in more than one year, the total number of personnel monitored cannot be obtained by adding the annual numbers. The total number of shipyard personnel monitored for radiation exposure associated with the Naval nuclear propulsion program has been about 115,000. Nearly all of these are civilians, almost half of whom are U. S. Government employees at six Naval shipyards. Table 4 provides further information about the distribution of their radiation exposures. In 1980 about 89 percent of those monitored for radiation in shipyards and about 99 percent of those in ships received less than 0.5 rem in a year, the limit allowed by Federal regulations for a member of the general public. The average exposure per year for each person monitored has been 0.34 rem in shipyards, which is less than one tenth the occupational exposure limit. The average exposure per year for those monitored in ships has been 0.12 rem, which is less than the annual exposure a person receives from natural background and medical radiation.

Table 4 also lists the numbers of personnel who have exceeded the 3 rem quarterly exposure limit. In no case have personnel exceeded the accumulated limit of 5 rem for each year of age over eighteen. The total number of persons who have exceeded the quarterly limit since the limit was imposed in 1959 is 37, of whom 4 were military personnel aboard ships. Thirty of the 37 personnel had quarterly exposures in the range of 3 to 4 rem, and the highest exposure was 9.7 rem in a quarter. Navy procedures require any person who receives greater than 25 rem in a short time period to be placed under medical observation. None of the exposures reached this level.

The average lifetime accumulated exposure from radiation associated with Naval nuclear plants for all shipyard personnel is 1.5 rem. Since the average annual exposure per person is 0.34 rem, this means that the average shipyard radiation worker is monitored because of Naval nuclear propulsion plant work for about four years. The average lifetime accumulated exposure for the 50,000 Naval officers and enlisted men trained to

TABLE 1

SHIPYARD FIRST REACTOR PLANT OPERATION AND FIRST RADIOACTIVE OVERHAUL WORK

Shipyard	Year First New Construction Reactor Started Operation	Year First Reactor Plant Overhaul Started
Electric Boat Division* Groton, Connecticut	1954	1957
Portsmouth Naval Shipyard Portsmouth, New Hampshire	1958	1959
Mare Island Naval Shipyard** Vallejo, California	1958	1962
Pearl Harbor Naval Shipyard Pearl Harbor, Hawaii	None	1962
Charleston Naval Shipyard** Charleston, South Carolina	None	1963
Newport News Shipbuilding and Dry Dock Company Newport News, Virginia	1960	1964
Bethlehem Steel Shipbuilding*** (Subsequently Electric Boat Division) Quincy, Massachusetts	1961	None
New York Shipbuilding Corporation*** Camden, New Jersey	1963	None
Norfolk Naval Shipyard Norfolk, Virginia	None	1965
Puget Sound Naval Shipyard** Bremerton, Washington	None	1967
Ingalls Shipbuilding Division Pascagoula, Mississippi	1961	1970

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* Electric Boat Division performed overhauls in 1957-1977 but only did new construction work again starting in 1978.

** Radioactive work of less extent than in an overhaul commenced in Mare Island in 1958, in Charleston in 1961, and in Puget Sound in 1965.

*** Work on Naval nuclear-powered ships was discontinued at Camden, New Jersey in 1967 and at Quincy, Massachusetts in 1969.

TABLE 2
OCCUPATIONAL RADIATION EXPOSURE RECEIVED BY PERSONNEL ASSIGNED TO TENDERS, BASES, AND NUCLEAR-POWERED SHIPS FROM OPERATION AND MAINTENANCE OF NAVAL NUCLEAR PROPULSION PLANTS

	Number of Persons Monitored Who Received Exposures In The Following Ranges of Rem for the Year						Total Personnel Monitored	Total Man-Rem
Year	0-1	1-2	2-3	3-4	4-5	> 5*		
1954	36	0	0	0	0	0	36	8
1955	90	11	0	0	0	0	101	25
1956	108	10	4	0	0	0	122	50
1957	293	7	1	0	0	0	301	60
1958	562	11	3	0	0	0	576	100
1959	1057	41	8	3	0	0	1109	200
1960	2607	88	8	4	3	1	2711	375
1961	4812	106	31	4	4	0	4957	680
1962	6788	182	75	31	17	1	7094	1312
1963	9188	197	39	14	3	1	9442	1420
1964	10317	331	93	35	15	4	10795	1964
1965	11883	592	224	96	30	24	12849	3421
1966	18118	541	156	95	44	28	18982	3529
1967	21028	339	139	48	11	0	21565	3084
1968	24200	373	103	20	2	0	24698	2463
1969	26969	577	127	39	6	0	27718	2918
1970	26206	610	134	30	0	0	26980	3089
1971	26090	568	122	31	2	0	26813	3261
1972	33312	602	180	13	1	0	34108	3271
1973	30852	600	102	15	1	0	31570	3160
1974	18375	307	65	2	0	0	18749	2142
1975	17638	330	28	1	0	0	17997	2217
1976	17795	369	56	9	0	0	18229	2642
1977	20236	346	95	36	3	0	20716	2812
1978	22089	290	23	1	0	0	22403	2234
1979	21121	75	1	0	0	0	21197	1528
1980	21563	78	0	0	0	0	21641	1494

Note: Data obtained from summaries rather than directly from original medical records. However, it is expected that the large effort to compile comparable data from original medical records would show differences no greater than five percent. Total man-rem was determined by adding actual exposures for each individual during the year.

* Limit in the Naval nuclear propulsion program was changed to 5 rem per year in 1967

TABLE 3
OCCUPATIONAL RADIATION EXPOSURE RECEIVED BY SHIPYARD PERSONNEL FROM WORK ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS

	Number of Persons Monitored Who Received Exposure In The Following Ranges of Rem For The Year						Total Personnel Monitored	Total Man-Rem
Year	0-1	1-2	2-3	3-4	4-5	>5*		
1954	508	9	3	5	3	0	528	64
1955	2563	80	25	6	3	2	2679	344
1956	2834	20	5	2	0	1	2862	162
1957	3473	97	31	1	2	4	3608	495
1958	5766	165	46	10	4	7	5998	779
1959	10388	221	133	78	49	23	10892	1864
1960	12047	198	97	22	4	0	12368	1158
1961	13383	198	91	44	14	3	13733	1241
1962	14411	642	366	247	146	108	15920	5222
1963	19164	446	159	71	34	28	19902	2725
1964	24044	804	445	215	144	41	25693	5678
1965	22630	2306	1314	814	618	525	28207	15829
1966	29490	2352	1623	1057	1139	513	36174	18804
1967	29853	2388	1563	1096	733	1	35634	13908
1968	30159	1344	773	496	279	0	33051	8719
1969	25672	1790	1080	753	375	0	29670	11077
1970	21182	2127	1382	740	492	0	25923	13084
1971	20041	1928	1066	650	240	0	23925	10616
1972	17514	1692	849	139	5	0	20199	7002
1973	13036	1403	604	203	6	0	15252	6083
1974	12587	1464	745	311	50	0	15157	7206
1975	12825	1116	598	82	42	0	14663	5285
1976	13042	1268	633	30	0	0	14973	5310
1977	13835	1277	586	25	0	0	15723	5199
1978	13700	1016	268	0	0	0	14984	3680
1979	15032	227	7	0	0	0	15266	2024
1980	15287	377	0	0	0	0	15664	2375

NOTE: Data obtained from summaries rather than directly from original medical records. However, it is expected that the large effort to compile comparable data from original medical records would show differences no greater than five percent. Total man-rem was determined by adding actual exposures for each individual during the year.

*Limit in the Naval nuclear propulsion program was changed to 5 rem per year in 1967.

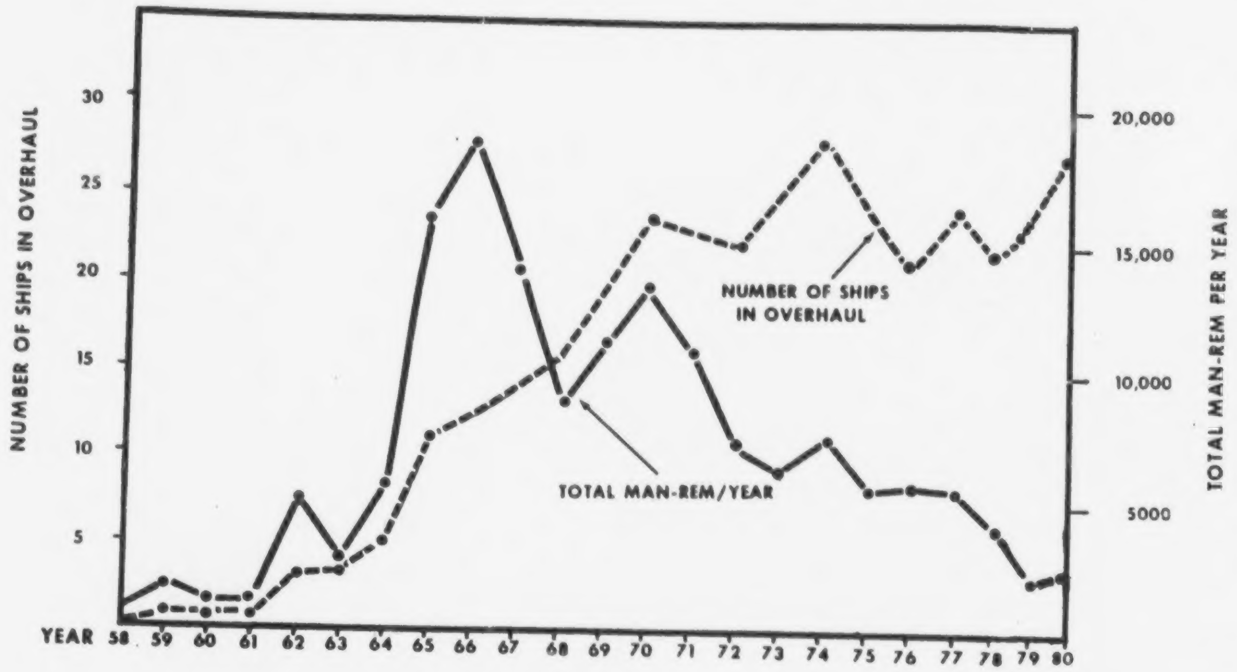

FIGURE 2

TOTAL RADIATION EXPOSURE RECEIVED BY SHIPYARD PERSONNEL
FROM WORK ASSOCIATED WITH NAVAL
NUCLEAR PROPULSION PLANTS
1958-1980

TABLE 4
SHIPYARD AND FLEET DISTRIBUTION OF PERSONNEL RADIATION EXPOSURE

Year	Average Rem Per Person Monitored		Percent of Personnel Monitored Who Received Greater Than 1 Rem		Number of Personnel Who Exceeded 3 Rem/Quarter
	Fleet	Shipyard	Fleet	Shipyard	
1954	.22	.12	0	3.8	0
1955	.25	.13	10.9	4.3	0
1956	.41	.06	11.5	1.0	0
1957	.20	.14	2.7	3.7	0
1958	.17	.13	2.4	3.9	0
1959	.18	.17	4.7	4.6	8
1960	.14	.09	7.5	2.6	0
1961	.14	.09	2.9	2.5	0
1962	.18	.33	4.3	9.5	9
1963	.15	.13	2.7	3.7	2
1964	.18	.22	4.4	6.4	4
1965	.27	.56	7.5	19.8	5
1966	.19	.52	4.6	18.5	6
1967	.14	.39	2.5	16.2	3
1968	.10	.26	2.0	8.8	0
1969	.11	.37	2.7	13.5	0
1970	.11	.50	2.9	18.3	0
1971	.12	.44	2.7	16.2	0
1972	.10	.35	2.3	13.3	0
1973	.10	.40	2.3	14.5	0
1974	.11	.48	2.0	17.0	0
1975	.12	.36	2.0	12.5	0
1976	.14	.35	2.4	12.9	0
1977	.14	.33	2.3	12.0	0
1978	.10	.24	1.4	8.5	0
1979	.07	.13	0.4	1.5	0
1980	.07	.15	0.4	2.4	0
Average	.12	.34	2.5	11.6	
NAVYWIDE AVERAGE	.24		7.4		

operate a nuclear propulsion plant is about 1 rem. These radiation exposures are much less than the exposure the average American receives from medical diagnostic X-rays during his working lifetime.

Table 5 provides information on the distribution of lifetime accumulated exposure for personnel assigned to tenders, bases and nuclear-powered ships. Typical lifetime exposures of shipyard personnel were discussed in ref (10). Table 5 includes all personnel who at some time in 1980 were monitored for radiation exposure. Federal radiation exposure limits allow accumulating 100 rem in twenty years of work, or 200 rem in forty years. The fact that no one shown in Table 5 comes close to having accumulated this much radiation exposure is the result of deliberate efforts to keep well below the lifetime accumulated radiation exposure limit.

TABLE 5
DISTRIBUTION OF TOTAL LIFETIME OCCUPATIONAL RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS

Range of Accumulated Lifetime Radiation Exposure (REM)	Percentage of Ship Personnel monitored in 1980 With Lifetime Accumulated Radiation Exposure in the Radiation Range
0 - 5	99
5 - 10	1
10 - 15	0.04
15 - 20	0.01
20 - 25	0.003
25 - 30	0
30 - 50	0
Greater than 50	0

Table 6 provides a basis for comparison between the radiation exposure for light water reactors operated by the Navy and commercial power reactors licensed by the Nuclear Regulatory Commission. The 1979 data in this Nuclear Regulatory Commission table covers 67 licensees with a total of 39,759 man-rem (ref 11). The 1979 average annual exposure of each worker at commercial power reactors was 0.36 rem.* Licensees of commercial power reactors reported 171 overexposures to external radiation during the years 1971 through 1979. Numbers in excess of 5 rem are not necessarily overexposures since Nuclear Regulatory Commission regulations permit exposures of 3 rem each quarter up to 12 rem per year within the accumulated total limit of 5 rem for each year of a person's age beyond eighteen.

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* This average was calculated by dividing total man-rem by total number of workers monitored as is done in Table 4. Ref (11) reports this value as 0.62; however it is calculated by dividing the total man-rem by the number of workers with measurable exposure.

TABLE 6

PERSONNEL
RADIATION EXPOSURE FOR COMMERCIAL NUCLEAR-POWERED REACTORS LICENSED
BY U.S. NUCLEAR REGULATORY COMMISSION

SUMMARY OF ANNUAL WHOLE BODY EXPOSURE BY INCREMENT

		NUMBER OF INDIVIDUALS													
		EXPOSURE INCREMENT - REM													
YEAR	TOTAL MONITORED	NOT MEASURABLE	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10	Total Man-Rem	No. Of Over-Exposures
1969	2838	2607			134	65	25	5	2	0	0	0	0		
1970	7509	6985			166	163	88	98	8	1	0	0	0		
1971	9581	8996			315	137	105	17	11	0	0	0	0		2
1972	15713	14783			532	199	111	46	21	9	6	6	0		16
1973	33823	19043	9798	2468	1584	422	251	71	38	16	7	0	0	13963	19
1974	38938	20472	13766	2503	1378	471	226	86	30	6	0	0	0	13722	43
1975	44343	18852	18289	3948	1872	691	423	169	60	24	12	0	1	20879	14
1976	61151	25704	24606	4880	2354	789	487	188	70	26	11	5	1	26433	20
1977	67134	24868	31298	6162	2837	1130	569	141	66	36	21	6	0	32511	27
1978	76121	30143	34983	6405	2989	1080	418	67	26	8	0	0	2	31804	9
1979	109160	45087	50974	7934	3307	1251	477	86	28	13	2	0	1	39759	21

SOURCE: NUREG-0713, "Occupational Radiation Exposures at Commercial Nuclear Power Reactors 1979"

INTERNAL RADIOACTIVITY

Policy and Limits

The Navy's policy on internal radioactivity for personnel associated with the nuclear propulsion program continues to be the same as it was more than two decades ago—to prevent significant radiation exposure to personnel from internal radioactivity. The limits invoked to achieve this objective are one-tenth of the levels allowed by Federal regulations for radiation workers. The results of this program have been that no one has received more than one-tenth the Federal annual internal occupational exposure limits from internal radiation exposure caused by radioactivity associated with Naval nuclear propulsion plants.

The basic Federal limit for radiation exposure to organs of the body from internal radioactivity has been 15 rem per year. There have been higher levels applied at various times for thyroid and for bones; however, use of these specific higher limits has not been necessary in the Naval nuclear propulsion program.

Fifteen rem per year is the limit recommended for most organs of the body by the U. S. National Committee on Radiation Protection in 1954 (ref 1), by the U. S. Atomic Energy Commission in the initial edition of ref 3 applicable in 1957, by the International Commission on Radiological Protection in 1959 (ref 2), and was adopted for Federal agencies when President Eisenhower approved recommendations of the Federal Radiation Council May 13, 1960. Although the International Commission on Radiological Protection revised its recommendations in 1977 (ref 8) to raise limits for most organs, the Naval nuclear propulsion program has not changed its limits.

Source of Radioactivity

Radioactivity can get inside the body through air, through water or food, and through surface contamination via the mouth, skin or a wound. The radioactivity of primary concern is the metallic corrosion products on the inside surfaces of reactor plant piping systems. These are in the form of insoluble metallic oxides, primarily iron oxides. Ref (12) contains more details on why cobalt 60 is the radionuclide of most concern for internal radioactivity.

The design conditions for reactor fuel are much more severe for warships than for commercial power reactors. As a result of being designed to withstand shock, naval reactor fuel elements retain fission products including fission gases within the fuel. Sensitive measurements are made frequently to verify the integrity of reactor fuel. Consequently, fission products such as strontium 90 and cesium 137 make no measurable contribution to internal exposure of personnel from radioactivity associated with Naval nuclear propulsion plants. Similarly alpha emitters such as uranium and plutonium are retained within the fuel elements and are not accessible to personnel operating or maintaining a Naval nuclear propulsion plant.

Because of the high integrity of reactor fuel and because soluble boron is not used in reactor coolant for normal radioactivity control in Naval reactors, the amounts of tritium in reactor coolant are far less than in typical commercial power reactors. The small amounts that are present are formed primarily as a result of neutron interaction with the deuterium naturally present in water. The radiation from tritium is of such low energy that the Federal limits for breathing or swallowing tritium are one hundred times higher than for cobalt 60. As a result radiation exposure to personnel from tritium is far too low to measure. Similarly, the low energy beta radiation from carbon 14 does not add measurable radiation exposure to personnel operating or maintaining Naval nuclear propulsion plants.

Control of Airborne Radioactivity

Airborne radioactivity is controlled in maintenance operations such that masks are not normally required. To prevent exposure of personnel to airborne radioactivity when work might expose radioactivity to the atmosphere, contamination containment tents or bags are used. The areas inside these containments are ventilated to the atmosphere through high efficiency filters which have been tested to remove at least 99.95 percent of particles of a size comparable to cigarette smoke. The occupied area outside these containments is required to be ventilated through high efficiency filters any time work which could cause airborne radioactivity is in progress inside an area such as a reactor compartment. Airborne radioactivity surveys are required to be performed regularly in radioactive work areas. Any time airborne radioactivity above the limit is detected in occupied areas, work which might be causing airborne radioactivity is stopped. This conservative action is taken to minimize internal radioactivity even though the Navy's airborne radioactivity limit would allow continuous breathing for forty hours per week throughout the year to reach an annual exposure to the lungs of one-tenth the Federal limit. Personnel are also trained to use masks when airborne radioactivity above the limit is detected. However, masks are seldom needed and are not relied upon as the first line of defense against airborne radioactivity.

It is not uncommon for airborne radioactivity above the limit to be caused by radon naturally present in the air. Atmospheric temperature inversion conditions can allow this buildup of radioactive particles from radon. Radon can build up above the limit in sealed or poorly ventilated rooms in homes or buildings made of stone. Most cases of airborne radioactivity above the limits in occupied areas in the Naval nuclear propulsion program have been caused by radioactive particles from radon and not from the reactor plant. Procedures have been developed to allow work to continue after it has been determined that the elevated airborne radioactivity is from naturally occurring radon.

Radon is also emitted from radium used for making dials luminous. There have been a number of cases where a single radium dial such as on a wristwatch has caused the entire atmosphere of a submarine to exceed the airborne radioactivity limit used for the nuclear propulsion plant. Radium in any form has been banned from submarines to prevent interference with keeping airborne radioactivity from the nuclear propulsion plant as low as *practicable*.

Control of Radioactive Surface Contamination

Perhaps the most restrictive regulations in the radiological control program are established in the requirements for the control of radioactive contamination. Work operations involving potential for spreading radioactive contamination are planned using containment to prevent personnel becoming contaminated. The controls for radioactive contamination are so strict that precautions sometimes have had to be taken to prevent tracking contamination from fallout and natural sources into nuclear areas because the contamination control limits used in the nuclear areas were below the levels of fallout and natural contamination occurring outside in the general public areas.

Anticontamination clothing, including coveralls, hood (to cover the head, ears and neck), shoe covers and gloves, is provided when needed. However, the basic approach is to avoid the need for anticontamination clothing by containing the radioactivity. As a result, most work on radioactive materials is performed with hands reaching into gloves installed in containments, making it unnecessary for the worker to wear anticontamination clothing. In addition to providing better control over the spread of radioactivity, this method has reduced radiation exposure since the worker can usually do his job better and faster in his normal work clothing. A basic requirement of contamination control is monitoring all personnel leaving any area where radioactive contamination could possibly occur. Workers are trained to survey themselves, and their performance is checked by radiological control personnel. Personnel monitor before, not after, they wash. Therefore, washing or showering at the exit of radioactive work areas is not required. The basic approach is to prevent contamination, not wash it away.

Surveys for radioactive contamination are taken frequently by trained radiological control personnel. Results of these surveys are reviewed by supervisory personnel to provide a double-check that no abnormal conditions exist. The instruments used for these surveys are checked against a radioactive calibration source daily and prior to use, and they are calibrated at least every six months.

Control of Food and Water

Smoking, eating, drinking and chewing are prohibited in radioactive areas. Aboard ship, drinking water is distilled from seawater by using steam. However, the steam is not radioactive because it is in a secondary piping system separate from the reactor plant radioactive water. In the event radioactivity were to leak into the steam system, sensitive radioactivity detection instruments which operate continuously would give early warning.

Wounds

Skin conditions or open wounds which might not readily be decontaminated are cause for disqualification from doing radioactive work. Workers are trained to report such conditions to radiological control or medical personnel, and radiological control technicians watch for open wounds when workers enter radioactive work areas. In the initial medical examination prior to radiation work and during subsequent examinations, skin conditions are also checked. If the medical officer determines a wound is sufficiently healed or considers the wound adequately protected, he may remove the disqualification.

There have been only a few cases of contaminated wounds in the Naval Nuclear Propulsion Program. In most years, none occurred. Examples of such injuries which have occured in the past include a scratched hand, a metallic sliver in a hand, a cut finger, and a puncture wound to a hand. These wounds occurred at the same time the person became contaminated. Insoluble metallic oxides which make up the radioactive contamination remain primarily at the wound rather than being absorbed into the blood stream. These radioactively contaminated wounds have been easily decontaminated. No case of a contaminated wound is known where the radioactivity initially present in the wound was as much as one one-thousandth of that permitted for a radiation worker to have in his body.

Monitoring for Internal Radioactivity

The radioactivity of most concern for internal radiation exposure from Naval nuclear propulsion plants is cobalt 60. Although most radiation exposure from cobalt 60 inside the body will be from beta radiation, the gammas given off make cobalt 60 easy to detect. Complex whole body counters are not required to detect cobalt 60 at low levels inside the body. For example, one millionth of a curie of cobalt 60 inside the lungs or intestines will cause a measurement of two times above the background reading with a standard radiation survey instrument. This amount of internal radioactivity will cause the instrument used to monitor personnel for radioactive contamination on their body to reach the alarm level. Every person is required to monitor his entire body every time he leaves an area with radioactive surface contamination. Monitoring the entire body is a requirement in the Naval nuclear propulsion program; monitoring just hands and feet is not permitted. Therefore, if a person had as little as a millionth of a curie of cobalt 60 inside him, it would readily be detected.

Swallowing one millionth of a curie of cobalt 60 will cause internal radiation exposure of about 0.06 rem. The radioactivity will pass through the body and be excreted within a period of a little more than one day.

One millionth of a curie of cobalt 60 deposited in the lungs as a result of an inhalation incident is estimated to cause a radiation exposure of about 3 rem to the lungs over the following year based on standard calculational techniques recommended by the International Commission on Radiological Protection, (ref 13). These techniques provide a convenient way to estimate the amount of radiation exposure a typical individual might be expected to receive from small amounts of internally deposited radioactivity. These techniques account for the gradual removal of cobalt 60 from the lungs through biological processes and the radioactive decay of cobalt 60 with a 5.3 year half life. However, if an actual case were to occur, the measured biological elimination rate would be used in determining the amount of radiation exposure received.

In addition to the control measures to prevent internal radioactivity and the whole body monitoring frequently performed on those who work with radioactive materials, more sensitive monitoring is also performed during radioactive overhaul work. Shipyard procedures for monitoring internal radioactivity use the type of scintillation detectors which will reliably detect an amount of cobalt 60 inside the body that is more than one hundred times lower than the one millionth of a curie used in the examples above. Shipyards typically monitor for internal radioactivity as part of each radiation medical examination, performed before an employee initially performs radiation work, after he terminates radiation work, and periodically in between. Shipyards also monitor periodically during the year groups of personnel who did the work most likely to have caused spread of radioactive contamination. Any person who has radioactive contamination above the limit anywhere on the skin of his body during regular monitoring at the exit from a radioactive area is monitored for internal radioactivity with the sensitive detector. Also any person who might have breathed airborne radioactivity above limits is monitored with the sensitive detector.

Results of Internal Monitoring in 1980

During 1980, one of the personnel monitored for internal radioactivity in the Naval Nuclear Propulsion Program was found to have internally deposited radioactivity above 0.01 millionth of a curie. This individual ingested approximately 0.017 millionth of a curie of insoluble cobalt 60 from a spill of radioactive liquid which sprayed him in the face. After two days, the quantity of internally deposited radioactivity had decreased to less than 0.01 millionth of a curie and was essentially eliminated by natural biological processes. The individual received a total exposure of 1.0 mrem to his intestines as the radioactivity passed through.

EFFECTS OF RADIATION ON PERSONNEL

Control of radiation exposure in the Naval nuclear propulsion program has always been based on the assumption that any exposure, no matter how small, involves some risk; however, exposure within the accepted exposure limits represents a risk small compared with normal hazards of life. The basis for this statement is presented below.

Exposure to Radiation Involves Some Risk

Since the inception of nuclear power, scientists have cautioned that exposure to ionizing radiation in addition to that from natural background involves some risk. The National Committee on Radiation Protection and Measurements in 1954 (ref 1) and the International Commission on Radiological Protection in 1958 (ref 2) both recommended that exposures should be kept as low as practicable and that unnecessary exposure should be avoided to minimize this risk. The International Commission on Radiological Protection in 1962 (ref 14) explained the assumed risk as follows:

> "The basis of the Commission's recommendations is that any exposure to radiation may carry some risk. The assumption has been made that, down to the lowest levels of dose, the risk of inducing disease or disability in an individual increases with the dose accumulated by the individual, but is small even at the maximum permissible levels recommended for occupational exposure."

The National Academy of Sciences-National Research Council Advisory Committee on the Biological Effects of Atomic Radiation included similar statements in its reports in the 1956-1961 period. In 1960, the Federal Radiation Council stated in ref 4 that its radiation protection guidance did not differ substantially from recommendations of the National Committee on Radiation Protection and Measurements, the International Commission on Radiological Protection, and the National Academy of Sciences.

One conclusion from these reports is that radiation exposures to personnel should be minimized. This is not a new conclusion. It has been a major driving force of the Naval nuclear propulsion program.

Studies of the Effects of Radiation on Humans

Tens of thousands of reports have been written on the effects of radiation. Even the list of summary reports is voluminous. In spite of the fact that there are many unanswered questions concerning the effects of radiation on humans, more is known about radiation than almost any substance that can affect humans. More money has been spent to learn the effects of radiation on humans than for any other hazard in our modern society. In fact, the National Academy of Sciences in ref 15 stated: "It is fair to say that we have more scientific evidence on the hazards of ionizing radiation than most, if not all, other environmental agents that affect the general public."

The main effect is cancer. Effects other than cancer have not been found for low-level radiation exposure to adults. While genetic effects from radiation can occur, no increase in the natural rate of genetic effects has been found in 35,000 children conceived by parents irradiated after the nuclear explosions in Hiroshima or Nagasaki in 1945. The following brief summary of the effects of low-level whole body external radiation is primarily from refs 15 and 16.

The most important data on the effects of whole body external radiation exposure on humans comes from the almost 30 years of extensive study of the Japanese atomic bomb survivors. In addition, studies have been made of the Marshall Islands inhabitants who received about 12,000 man-rem from fallout in 1954. Studies have been made on groups of patients who have had frequent diagnostic x-ray examinations. Numbers of studies have been made on patients who have had radiation therapy for a disease of the bones of the back and for other conditions. These studies predominantly involved radiation doses of greater than 100 rem. The determinations of damage from doses greater than 100 rem have been reasonably consistent from numerous different studies. Extensive irradiation studies of animals have also been used to show what to look for in humans. These animal studies also show under controlled conditions not available in studies on humans how the radiation effects change with amount and frequency of radiation exposure.

Results of radiation studies on humans show the highest rates of cancer occur in the thyroid and the female breast, although the death rate for thyroid cancer is low. The cancer rates from radiation are lower for leukemia and lung cancer, and lower still for cancers of the bone and other organs. Leukemia has been associated with radiation exposure in almost every study of radiation on humans. Reasons for this include the improved diagnosis of leukemia in recent decades and the low natural incidence of leukemia compared to other cancers. However one type of leukemia, chronic lymphatic leukemia, has not been found in any study to be associated with radiation.

Some organs appear to be so resistant to radiation-induced cancer that there has been no clear association between radiation and cancer in these organs. One example is the prostate gland. In addition, according to ref 15, the radiation exposure required to cause sterility in males is very high, probably in excess of lethal exposures.

Cataracts of the eyes can be caused by radiation. However, cataract formation appears to have more evidence of having a threshold radiation dose than any other radiation damage studied. Very high radiation doses have been required to produce cataracts. Ref 8 concludes that 1500 rem is below the threshold for producing damage to the lens of the eye sufficient to interfere with vision.

One characteristic of cancer caused by low-level radiation is the long delay time between time of radiation exposure and time of diagnosis of cancer. Cancer is not diagnosed until more than a few years have elapsed. In the Japanese atomic bomb survivors, the end of the latent period for leukemia was about 25 years. For the sum of all types of cancers ref 16 assumes that in 25 years one half the cancers will have occurred.

Scientific reports of several decades ago speculated that radiation might cause a general effect that would shorten life, similar to aging. Reports in the last decade conclude such an effect has not been found in studies on humans. Nor have numerous other diseases such as heart disease been associated with radiation in these studies. To date the chief effect of radiation on humans has been found to be cancer.

In 1980, the National Institute for Occupational Safety and Health issued a report (ref 17) concerning the health of Portsmouth Naval Shipyard workers.

In 1978, Dr. T. Najarian, assisted by the Boston Globe, issued a sensationalized report which alleged that Portsmouth Naval Shipyard (PNS) workers who were occupationally exposed to low-level radiation suffered twice the expected rate of overall cancer deaths and five times the expected rate of leukemia deaths. This report was based on an informal review of several hundred death records, without any official input. It caused a number of frightening news stories. NIOSH was subsequently directed by Congress to investigate Dr. Najarian's report.

Under contract with NIOSH, Dr. Najarian's study was repeated using data the Navy made available to NIOSH. In June 1979, Dr. Najarian testified before Congress on the results of the reanalysis based on official data. In his testimony Dr. Najarian repudiated his earlier findings of increased overall cancer and leukemia. His third finding of increased blood cancers was separately repudiated at that time by the National Cancer Institute.

In December 1980, NIOSH finished their investigation based on approximately 25,000 Portsmouth Naval Shipyard workers and issued a final report. This report states that NIOSH found no excess of deaths due to leukemia or other cancers among the Shipyard workers. This report specifically states:

> "No relationship between exposure to radiation and mortality from any cause was observed among the PNS population when compared to the United States white male population. Furthermore, no excess in leukemia mortality was observed in the radiation exposed population when compared to the non-radiation exposed employees of PNS."

Thus, the earlier reports of excess cancer rates among Portsmouth Naval Shipyard workers exposed to low-level radiation were not substantiated by NIOSH.

The Department of Energy is sponsoring a more comprehensive shipyard epidemiologic study. The study is being performed by Johns Hopkins University and will include radiation workers in all shipyards doing Naval nuclear propulsion plant work so that its findings will be based on a much larger population. Because of the size of the study, results are not expected for approximately 10 years.

Numerical Estimates of Risk from Radiation

In 1972 both the United Nations Scientific Committee on the Effects of Atomic Radiation and the National Academy of Sciences-National Research Council Advisory Committee on the Biological Effects of Ionizing Radiations issued reports (refs 18 and 19) estimated numerical risks for specific types of cancer from radiation exposure to humans. In 1977, both the International Commission on Radiological Protection and the United Nations Scientific Committee on the Effects of Atomic Radiation issued reports (refs 8 and 16) reconfirming these risk estimates. The risk estimates from both refs 8 and 16 can be briefly summarized as follows:

> In a large population group (such as 100,000 people) receiving an annual total of 10,000 man-rem year after year, the increased risk from this radiation appears to be in the region of about one fatal cancer case each year and about one leukemia case every five years in excess of the normal numbers of cases.

This can be used to develop a risk estimate for personnel exposed to radiation associated with Naval nuclear propulsion plants. In all shipyards there have been a total of about 115,000 personnel monitored for exposure to radiation, and their exposure rate has averaged somewhat less than 10,000 man-rem per year. Therefore, there should be less than one excess fatal cancer per year and less than one excess leukemia case every five years among the total 115,000 shipyard personnel who have ever been monitored for radiation associated with Naval nuclear propulsion plants.

According to refs 8 and 16 this risk estimate is likely to be substantially overstated because the radiation exposures are from gamma radiation at low doses and low dose rates. Also, exposure to neutrons and exposure from internal radioactivity in the Naval nuclear propulsion program are too low to have the confusing effects noted in some studies of the effects of radiation on humans. The National Academy of Sciences-National Research Council Committee on Biological Effects of Ionizing Radiation issued a report in 1980 (ref 15) which also stated that the risk estimates in refs 8 and 16 for low-level exposure were substantially overestimated. This report recommended that the risk of dying of cancer from low-level radiation exposure be estimated based on a model which yields lower risk estimates than those reported in refs 8 and 16. For simplicity, the discussion which follows will use the earlier conservative estimates in refs 8 and 16.

Radiation exposure received by Naval personnel assigned to nuclear-powered ships and their support facilities has averaged less than 3000 man-rem per year. Therefore, according to refs 8 and 16 there should be less than one excess fatal cancer every three years and less than one excess leukemia case every fifteen years among the approximately 50,000 Naval personnel who have ever been monitored for occupational exposure to radiation associated with Naval nuclear propulsion plants. Since only a few percent of the total man-rem to ship personnel is from neutrons, the same qualifications apply as were mentioned for shipyard personnel, and this risk estimate is likely to be substantially overestimated.

Radiation Exposure Comparisons

To help put this risk estimate in perspective, comparisions are needed. For example, in a typical group of 10,000 people in the U. S., a total of 1600 will die of cancer (ref 20). If each of the 10,000 received over his lifetime one rem more than he was already receiving from background and medical sources, then according to the preceding risk estimate one extra person would die of cancer. Therefore, the 1600 cancer deaths would increase to 1601 for this group of 10,000. This example is directly applicable to the Naval nuclear propulsion program where the average lifetime occupational radiation exposure is one rem.

However, a few highly controversial studies have concluded that more people would die from radiation than the National Academy of Sciences and United Nations committees predict. If the higher risk estimate of one well known study is applied to the same population group of 10,000, then the 1600 cancer deaths would increase to 1610.

The current controversy over effects of low-level radiation is whether one extra rem to each of 10,000 people will cause the normal number of 1600 cancer deaths to increase to 1601, or to 1610. The 1601 figure is the current best estimate. Studies are now underway to attempt to refine the accuracy of the estimates.

The following examples give further perspective on what radiation exposure means:

- Of all industrial and medical radiation workers in the United States, about 15,000 die each year from cancer. It is estimated that only 25 additional cancer deaths occur per year as a result of radiation exposure from their work.

- Radiation from the nuclear accident at Three Mile Island may add one fatal cancer death to the public within fifty miles. Of the two million people living within this fifty mile radius, more than 300,000 are expected to die of cancer from causes other than the radioactivity released from this accident.

- The average occupational radiation exposure of all those monitored in the Naval nuclear propulsion program is about 0.25 rem per year. This is only slightly greater than the average radiation exposure received in the U. S. each year from natural background and medical x-rays. (Derived from ref 21).

- The average lifetime occupational radiation exposure of one rem for personnel in the Naval nuclear propulsion program is less than one tenth the amount of radiation exposure these same personnel will average over their lifetimes from natural background and medical x-rays. (Derived from ref 21).

- This one rem average lifetime occupational radiation exposure can also be compared very roughly to the 5 rem received in a year from smoking one pack of cigarettes per day. This comparison is not exact because it requires more lung exposure from natural radioactivity in tobacco to cause the same amount of risk as whole body gamma radiation. (ref 22)

- The risk of dying from an automobile accident is forty or more times higher than the risk of fatal cancer for the average person with 1 rem lifetime radiation exposure.

The total occupational radiation exposure of 3869 man-rem received by all personnel in the Naval nuclear propulsion program in 1980 can be compared to the many other sources of radiation exposure received by the U. S. population. Examples follow:

- 20,000,000 man-rem to the population of the U. S. each year from natural background radiation (ref 21).

- 17,000,000 man-rem to the population of the U. S. each year from medical and dental radiation (ref 21).

- 650,000 man-rem to the population of the U. S. each year from radioactivity in natural gas used for cooking (ref 22).

- 100,000 man-rem the one million inhabitants of Denver could save each year if they moved to a region such as Washington, D. C. with lower natural background radiation levels (Derived from ref 21).

- 12,000 man-rem total to passengers in jet airplane flights in the United States from increased cosmic radiation at the higher altitudes used by jets (ref 23).

Thus, the total occupational radiation exposure received by all personnel in 1980 is less than one ten-thousandth of the total radiation exposure received by the U. S. population from all sources. The risk from occupational radiation exposure in the Naval nuclear propulsion program is also less than the risks these same personnel face from natural background radiation or from medical radiation. To demonstrate this, the 115,000 personnel monitored for radiation in all shipyards over the last 26 years will receive about 11,500 man-rem per year from natural background and about the same from medical radiation. The average occupational exposure to this group has been less than 10,000 man-rem per year.

Risk estimates for radiation should also be compared to other risks normally encountered in industrial activities, using the following table for example:

DEATH RATES IN U. S. FOR VARIOUS CAUSES

CAUSE	ANNUAL DEATHS PER 100,000 POPULATION
Smoking (ref 24)	150
Motor Vehicle accidents (ref 25)	22
Work accidents (ref 25)	
Mining, quarrying	63
Construction	57
Agriculture	54
Transportation and Public Utilities	31
All Industries Average	14
Government	11
Services	9
Manufacturing	9
Trade	6
Industrial accidents in a Naval Shipyard (eight shipyards 1972-1977)	7
Commercial air travel (ref 25)	1
Coal-fired electric power (estimate derived from ref 26)	1 to 10
Radiation associated with Naval Nuclear propulsion plants (risk estimate)	Less than 1

Because of these estimates on the risk of low-level radiation, extra hazard pay for radiation work has never been paid in the Naval nuclear propulsion program. Civil Service Commission regulations do not provide for hazard pay for radiation work. A serious disadvantage to extra pay for radiation risks is that it would tend to increase the difficulty in minimizing radiation exposure because some personnel would press for more radiation to maximize their pay.

Extrapolations

In radiation, as in other areas, a most effective way to frighten people is to proclaim that no one knows what the effects are. This has been repeated so often that it has almost become an article of faith that no one knows the effects of low-level radiation on humans.

One could well state, "No one knows the risks of smoking a few cigarettes," but the risks of smoking a large number of cigarettes are well known. If 10,000 people smoke an average of four cigarettes a day, about 100 deaths will result; data are not available for lower smoking rates. For radiation, doses of 100 rem to each of 10,000 people would be required to cause an equal number of deaths. The effects of radiation on humans at doses of 100 rem are well known. The controversy over radiation risks today is how to extend the risk estimates to even lower levels. As we get to lower levels, it becomes more and more difficult to detect the effects, and this becomes a problem.

The figures just presented can be extended to show that one rem has about the same risk of death as smoking one cigarette per month. This comparison is only to show that finding out the effect on the death rate of one rem of exposure is about the same as trying to find out the effect of smoking one cigarette a month.

In summary, the effect of one rem is extremely small. There are physical limits to how far scientists can go to ascertain precisely the size of this risk, but it is known to be small. Instead of proclaiming how little is known about low-level radiation, it is more appropriate to emphasize how much is known about the small actual effects.

Conclusions on the Effects of Radiation on Personnel

This perspective provides a better position to answer the question, "Is radiation safe?" If safe means zero effect, then the conclusion would have to be that radiation is unsafe. But to be consistent, background radiation and medical radiation would also have to be considered unsafe. Or more simply, being alive is unsafe.

"Safe" is a relative term. Comparisons are necessary for actual meaning. For a worker, safe means the risk is small compared to other risks accepted in normal work activities. Aside from work, safe means the risk is small compared to other risks routinely accepted in life.

Each recommendation on limits for radiation exposure from the key organizations referenced has emphasized the need to minimize radiation exposure. Thus, the Navy is committed to keeping radiation exposure to personnel as low as reasonably achievable. No level of radiation exposure has been identified for which responsible organizations have stated there is no effect. Similarly it is difficult to find a single activity of man for which one can confidently state the risk is zero. However, the above summaries show that the risk from radiation exposure associated with Naval nuclear propulsion plants is low compared to hazards normally accepted in industrial work and in daily life outside of work.

CLAIMS FOR RADIATION INJURY TO PERSONNEL

Personnel who consider they have or might have had occupational injury are encouraged to file claims. The compensation systems make allowance for the long latent period for radiation-induced cancer. Naval shipyard personnel are employees of the U. S. Government and therefore file claims with the U. S. Department of Labor's Office of Workmen's Compensation. Shipyards hold no hearing on injury claims. They are not handled in an adversary procedure. The Navy has no rights to present a case to the Labor Department. The claim does not even have to be filed through the shipyard. The shipyard is not permitted to appeal a decision, but the employee may appeal. The primary consideration in the Federal laws and procedures set up for injury compensation is to take care of the Federal employee. The program to compensate Federal employees is well publicized.

In private shipyards injury compensation claims are handled under the Longshoreman's and Harbor Workers' Compensation Act. The claim may be handled through the shipyard's insurance carrier or by a U. S. Department of Labor claims examiner. Either the employee or the employer may appeal.

Claims for military personnel concerning prior duty are handled through the Veterans Administration.

There have been a total of 101 claims filed for injury from radiation associated with Naval nuclear propulsion plants. Eighty-four originated from employees of the six Naval shipyards, fifteen from private shipyards and two from Navy personnel. These claims are summarized in Table 7. As shown in Table 7 more than half the claims have been filed for injuries other than cancer or leukemia. Two-thirds of the claims filed for cancer or leukemia involved workers with lifetime radiation exposures less than the 5 rem a nuclear worker is permitted to receive in one year by Federal Regulations.

Two suits have been filed in court alleging injury from radiation. Neither person claims cancer. One was dismissed in 1979 and the other is still in litigation.

Five claims have been awarded, two for leukemia in 1968 and 1979 and three for cataracts of the eyes in 1971, 1974 and 1977. The Navy considers all five of these awards were incorrect:

- One leukemia case had an occupational exposure of 5.38 rem. The claimant had also received hundreds of rem in medical radiation exposure for adenoids. If radiation were to be selected as the cause of this leukemia, then the occupational exposure could not have been more than a tiny part of this total radiation exposure.

- The second leukemia case had a total occupational exposure of 1.00 rem. This amount of radiation exposure is small and less than 10 percent of the amount of exposure the claimant will receive during his life from natural background radiation.

- Two of the cataract cases had total lifetime radiation exposures of about 3 rem, and one case had less than 1 rem. These exposures are hundreds of times smaller than needed to produce cataracts in the eyes.

From the radiation injury claims filed to date, the Navy has been unable to draw any conclusions concerning radiation injury to personnel occupationally exposed to radiation associated with Naval nuclear propulsion plants.

TABLE 7

CLAIMS FOR RADIATION INJURY TO PERSONNEL

Injury Claimed	Claims Filed	Claims Awarded	Claims Denied or Deferred	Claims Active
Leukemia	17	2	6	9
Cancer Other Than Leukemia	27	0	16	11
Other	57	3	32	22
Total	101	5	54	42

AUDITS AND REVIEWS

Checks and cross-checks and audits and inspections of numerous kinds have been shown to be essential in maintaining high standards of radiological control. First, each worker is specially trained in radiological control as it relates to his own job. Second, written procedures exist which require verbatim compliance. Third, radiological control technicians and their supervisors oversee radioactive work. Fourth, personnel independent of radiological control technicians are responsible for personnel radiation exposure records.

Fifth, a strong independent audit program is required covering all radiological control requirements. In all shipyards this radiological audit group is independent of the radiological control organization and its findings are reported regularly to senior shipyard management, including the shipyard commander. This group performs continuing surveillance of radioactive work. It conducts in-depth audits of specific areas of radiological control. This group checks all radiological control requirements at least annually.

Sixth, the U. S. Department of Energy assigns to each shipyard a representative who reports to the Deputy Assistant Secretary for Naval Reactors at headquarters. One assistant to this representative is assigned full time to audit radiological controls, both in nuclear-powered ships and in the shipyard. And seventh, the Naval Sea Systems Command also conducts periodic inspections of radiological control in each shipyard. Similarly, there are multiple levels of audits and inspections for the other Navy shore facilities, tenders, and nuclear-powered ships.

ABNORMAL OCCURRENCES

It is a fact of human nature that people make mistakes. The key to a good radiological control program is to find the mistakes while they are small and prevent the combinations of mistakes that lead to accidents. The preceding section on inspections supports the contention that more attention is given to errors and their prevention in the Naval nuclear propulsion program than to any other single subject. Requiring constant focus on improving performance of radiological work has proven effective in reducing errors.

In addition, radiological control technicians are authorized and required to stop anyone performing work in a manner which could lead to radiological deficiencies. A deficiency, of course is failure to follow a written procedure verbatim. However, the broadest interpretation of the term "deficiency" is used in the Navy's radiological control program. Anything involved with radiation or radioactivity which could have been done better is also a radiological deficiency.

Radiological deficiencies receive management attention. But there is a higher level of deficiency that is defined as a radiological incident. Incidents attract a great deal of notice, including the personal attention of the Deputy Assistant Secretary for Naval Reactors at headquarters. Improvement programs over the years have constantly aimed at reducing the numbers of radiological incidents. As improvements occurred, the definition of what constituted an incident was changed to define smaller deficiencies as incidents. These changes were necessary so that the incident reporting system would continue to play a key role in upgrading radiological controls. As a result, it is not practicable to measure performance merely by counting numbers of radiological incidents or deficiencies.

There is a reporting system that has been nearly constant over time and therefore can be used as a basis for comparison. The Department of Energy and its predecessors have used these levels of severity to define radiological occurrences (ref 27). Examples of radiation exposure incidents in each type follow:

- Type A - external radiation exposure over 25 rem in one incident
- Type B - external radiation exposure over 5 rem in one incident
- Type C - external whole body radiation exposure over 3 rem in one quarter year

The Nuclear Regulatory Commission also has criteria defining abnormal occurrences. The Navy regularly evaluates radiological events using these criteria for comparison; results are reported in Table 8.

TABLE 8

ABNORMAL OCCURRENCES IN THE NAVAL NUCLEAR PROPULSION PROGRAM

Year	Number of Abnormal Occurrences*
1975	0
1976	0
1977	0
1978	0
1979	0
1980	0

*Abnormal occurrences are reported here if the Navy evaluation determines they meet either the Department of Energy criteria for Type A radiation exposure incidents or the Nuclear Regulatory Commission criteria for quarterly report to Congress as abnormal radiation exposure occurrences.

The policy of the Navy is to provide for close cooperation and effective communication with state radiological officials involving occurrences that might cause concern because of radiological effects associated with the ships or shore facilities. The Navy has reviewed radiological matters with state radiological officials in the states where Naval nuclear-powered ships are based or overhauled. Although there were no recent occurrences which resulted in radiological effects to the public outside these facilities or which resulted in radiological injury to residents of the states working inside these facilities, states were notified when inquiries showed public interest in the possibility such events had occurred.

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Senator **Warner.** Admiral, if you would point out the highlights of your statement for purposes of introduction, then we will go into the details of the items you think are pertinent.

Admiral **Rickover.** With your permission, sir, I would like to mention some statistics of the program to give you a concept of what a large program we are considering.

NAVAL NUCLEAR PROPULSION PROGRAM

We now have 116 nuclear submarines in operation. Thirty-five of these are Polaris type and 81 are attack-type submarines. We also have 23 more attack type and 9 Tridents under construction or authorized. We have three nuclear carriers in operation and two more authorized. We have nine nuclear cruisers in operation.

The distance which has been steamed by all our nuclear ships has been over 47 million miles. I mention that figure to give you a concept of the vast amount of work that they have done and how reliable they are.

We have 157 nuclear reactors in operation, which is more than the total of all other power reactors in the United States. The number of reactor-years of operation in the Navy has been over 2,100.

In the 27 years of the naval nuclear propulsion program, since the Nautilus land prototype first operated, there has never been an accident involving a reactor, nor has there been any release of radioactivity which has had a significant effect on the environment during the entire history of this program.

When we started out we estimated that the first nuclear core would last 15,000 miles. It actually lasted 62,000 miles. The latest submarine core lasts 400,000 miles. That gives you an idea of the advances we have made.

As I mentioned to you earlier, my objective is to develop a core, which I am beginning work on now, that will last the 30-year life of the ship, so that we will only have to fuel a ship once in its life. That is a very fine goal, particularly if a war intervenes where the ships can keep on fighting without the Navy being concerned over taking ships off the line for refueling.

Senator **Warner.** Admiral, we talked earlier about the life of the ship. You have measured this new core against a 30-year period, but I feel you have a different view on the life of a ship.

Admiral **Rickover.** I do, Senator. I believe that these ships can be made to last quite a bit longer than 30 years. If they are kept in good condition, I see no reason why one should arbitrarily use that figure. I trust and I hope that there will be something in your report which encourages the Navy to extend ship lifetime, because these ships are getting very expensive and we are asking the taxpayers to spend a lot of money on military matters. Anything that any of us in the military can do, any concept we have, which will reduce the burden on our taxpayers is worthwhile and I am sure you thoroughly agree with that concept.

Returning to the naval nuclear propulsion program, the total number of officers and enlisted men trained or in training to date is over 50,000. This figure gives you an idea of the size of the program. The nuclear propulsion provides the Navy with ships having virtually unlimited high-speed endurance and freedom from the logistics umbilical cord for propulsion fuel.

The naval and civilian reactor development work for which I am responsible is under the cognizance of the Assistant Secretary for Nuclear Energy, who is assigned all reactor development and safety work for the Department of Energy. This organization arrangement, which is incorporated in the current Department of Energy Organizational Act, allows the most effective interchange of reactor development and safety technology for the benefit of all reactor work, and should be continued.

What I am getting at, briefly, is that I have a dual job in the Energy Department and the Navy. In this way, the same person and the same organization are responsible for the whole ball of wax. I do not know how the job can be separated because safety is indivisible. If at any time someone tried to split this job, it would be very dangerous because you cannot divide the responsibility for safety.

This way, as far as Congress is concerned, you can look to one individual and one organization for the entire operation—for the training of the people, for the operation of the reactors, for safety, and for all related matters.

This has worked. However, there occasionally rise up some people in the Defense Department who think it ought to be broken up. This, of course, would be a good idea from one standpoint; there would be more admirals, and that is to some a very desirable thing. [Laughter.] But in the way I operate the overhead is kept to a bare minimum and attention is focused on safety.

As far as Congress is concerned, you don't care who spends the dollar, whether it is the Defense Department or the Energy Department. This way fewer dollars are spent and you get greater efficiency.

Now, I think I have done enough bragging.

I would now like to get down to the point of what I am really here for, having gone into these preliminary remarks—we need some money.

Senator **Warner**. You need not refer to your remarks as bragging. The record speaks for itself in terms of safety and the contribution to our Nation's defense.

INCREASE IN BUDGET ASKED

Admiral **Rickover**. We are asking in this budget for $361.5 million, which is an increase of $58 million over last year. The increase is primarily due to escalation, increased effort on ongoing nuclear core development work, and an increase in construction activity.

The important thing is the construction work. It includes $35 million for modifying prototype facilities in the construction project which was fully authorized in fiscal 1981.

NAVAL FUEL FACILITY

An additional $15 million is to initiate design and construction for a materials facility to provide a second source for the production of naval nuclear fuel. The facility will be located at the Department of Energy's Savannah River site.

At present, the shutdown of the one fuel supplier would quickly jeopardize the fuel supply needed to support the nuclear powered fleet.

As far as I am concerned, this is the major purpose of this hearing. As I mentioned, an assured supply of nuclear fuel is vital.

Nuclear powered naval warships now constitute over 40 percent of the Navy's combatant fleet, including the entire strategic ballistic missile submarine force. Sole-source dependence subjects the Government to the risk of prolonged disruption in fuel supplies because of strikes, operational or regulatory directed shutdowns, natural catastrophes or unanticipated problems. A 4-month disruption in the supply of naval nuclear fuel last year reduced the already limited inventory and temporarily stopped urgent fuel development work.

Efforts to get the qualified commercial sources to invest in a fuel facility have been unsuccessful. I have tried, because I am a firm believer in not having the Government do the work when we can get commercial sources; but the investment is so large for them, and the amount of business is so relatively small, that the venture would not be economically feasible for commercial sources.

Under the circumstances, the best course of action is to construct a second fuel facility at a Government site. The Department of Energy's Savannah River site is the best location. The site offers an operating contractor, DuPont, that is an experienced, proven, and substantial defense contractor and chemical company. As you know, they have been involved in nuclear power from its inception, ever since the start of the Manhattan project.

Also, the site is located on the east coast, where the core manufacturing facilities are located, in this way minimizing transportation of nuclear fuel.

SOURCE FOR NAVAL NUCLEAR FUEL

That is the main thrust of my testimony this morning: We simply have to have a second source for naval nuclear fuel.

Senator **Warner**. Admiral, Secretary Edwards included this in his budget. We do not have in the record, however, any statement in the context of an overview by the Secretary.

Admiral **Rickover**. Yes, sir; I will provide that for the record. I will ask Secretary Edwards to give me a statement which I will include, with your permission, in the record.

Senator **Warner**. Thank you very much.

[The information requested follows:]

The Secretary of Energy,
Washington, D.C., June 10, 1981.

Dear Senator Warner: I understand that during Admiral Rickover's testimony before your Subcommittee on May 5, 1981, you asked the extent of my support for the $15 million requested in the Fiscal Year 1982 Department of Energy budget to start work on building a Naval nuclear fuel facility at the Department of Energy's Savannah River site.

I strongly endorse this project and urge that your Subcommittee approve the $15 million requested for this purpose in Fiscal Year 1982.

The only supplier of Naval nuclear fuel is Nuclear Fuel Services at Erwin, Tennessee, a commercial fuel vendor licensed by the Nuclear Regulatory Commission. Strikes, operational or regulatory shutdowns, natural disasters or other unanticipated problems at this plant can jeopardize fuel supplies for the nuclear powered ships which constitute over 40 percent of the Navy's major combatant fleet. For example, in 1979 a 4-month shutdown of the Nuclear Fuel Services plant reduced the already limited fuel inventory and temporarily stopped urgent fuel development work. This shutdown underscores the need for a second source.

Discussions with several qualified firms show that the high cost of facilities required in relation to the potential volume of business, coupled with the risk and uncertainty associated with producing highly enriched uranium, makes establishing a fuel plant commercially unattractive. Negotiations with two firms that submitted proposals make it clear that the Government would have to finance the construction of a commercial facility. This would leave the Government in the difficult and unattractive position of having a Government-funded facility controlled by a contractor.

The Department has, therefore, concluded that the Government's best interest would be served by constructing the fuel facility at the Savannah River site. This site offers appropriate safeguard and security measures and assures continuity of fuel manufacture for national defense. Because developing a second fuel source at the earliest date is so important, the Department has authorized Du Pont, the on-site prime contractor at Savannah River, to proceed immediately with initial conceptual work using Fiscal Year 1981 operating funds. The $15 million in Fiscal Year 1982 funds is required to perform detailed design effort to support early construction. The Department will need to spend at the rate of about $2.5 million in the first quarter of Fiscal Year 1982, building to about $5 million in the last quarter of Fiscal Year 1982.

Failure to provide the $15 million requested would delay the date by which we would have a second source for Naval nuclear fuel. This would result in higher construction costs, and, in the event of interrupted fuel supplies, disruption of urgent fuel development work and possible delay claims from core manufacturers and shipbuilders. In addition, an extended disruption of fuel supplies could impact the availability of fuel for operating nuclear ships.

I urge your favorable consideration of the full funding requested for this item.

Sincerely,

JAMES B. EDWARDS.

Senator WARNER. Admiral, you have $15 million in your budget to start this second naval nuclear facility at Savannah River. Where is your nuclear fuel made now?

Admiral RICKOVER. In Irwin, Tenn., at the Nuclear Fuel Services Co.

Senator WARNER. Would that plant continue?

Admiral RICKOVER. Yes, it is going to continue.

Senator WARNER. I want to make the record very clear on it.

Admiral RICKOVER. Yes, sir. Nuclear Fuel Services will continue to supply naval nuclear fuel to the program.

Senator WARNER. Then the need for a second facility arises for what reason?

Admiral RICKOVER. Because we need more fuel and we must have more than one source. If the one existing source is shut down, it would drastically affect the entire Navy's nuclear program.

Senator WARNER. So there are national security considerations here?

Admiral RICKOVER. Yes, sir. We have never contemplated shutting the present Nuclear Fuel Services plant down.

Senator WARNER. I presume that redundancy overrides any possible cost savings from enlarging the one plant?

Admiral RICKOVER. Yes, it does, and there wouldn't be much cost saving from enlarging the current plant, either.

Senator WARNER. What would be the projected total cost of the new facility?

Admiral RICKOVER. The rough estimate from DuPont was $300 million. We hope to do it for less than that, and expect a better cost estimate in the near future.

Senator **Warner**. What would be the final timeframe within which you would bring in the IOC of this plant? You are now asking for $15 million for basic design?

Admiral **Rickover**. Somewhere from 3 to 4 years. We should get started as fast as we can. The money we are asking for initially is primarily for architect and engineering work.

Senator **Warner**. The existing facilities are licensed by the NRC. What are your intentions with respect to the new facility?

Admiral **Rickover**. The new facility will be a part of the Savannah River operation, which is controlled by DOE and would not be licensed by the NRC, just as the other activities at Savannah River are not licensed.

Senator **Warner**. I am advised by counsel that the House has cut your request to $3 million. Could you give me the background on that?

Admiral **Rickover**. First, they went along with authorizing it. So the $3 million is a vote of confidence in what we are doing; but they apparently don't believe they have enough money for other purposes. We would like to get $15 million. The most economical and expeditious way of proceeding is to get $15 million this year.

Senator **Warner**. This committee is likely to go ahead with the $15 million and the House with the $3 million. I will be responsible for examining the reasoning behind that $3 million. Could you elaborate?

Admiral **Rickover**. We were not told a specific reason for the lesser amount, sir. There certainly will be no saving in money. In fact, authorizing a smaller amount this year will probably increase the total cost, because the project would drag on, and as it drags on, it will take more money.

Senator **Warner**. We are joined at this time, Admiral, by Senator Thurmond and Senator Exon.

I welcome my colleagues and will defer to both at this point.

The admiral's complete statement, which I hope you will have an opportunity to examine because it traces the entire history of the Navy's program, will be included in the record.

We are now addressing the need for the United States to have a second plant for the purpose of manufacturing nuclear fuel for naval vessels.

Senator Thurmond?

Senator **Thurmond**. Admiral Rickover, it is a pleasure once again to welcome you back to this committee. Your remarks are always welcome. You always speak candidly and do not hesitate to give your opinion.

You have made quite a contribution to this country. We now have 128 operating nuclear-powered warships, all with outstanding safety and operational records. The performance of our nuclear-powered warships in the Indian Ocean during the Iranian crisis proved once again the advantage of nuclear power which you have been espousing for more than a quarter of a century. You can be assured of my continuing support of this program.

I hope you will continue to serve this country. We need people of your wisdom and vision. I look forward to seeing you before this committee for many years to come.

I see that you are asking for $15 million this year to start construction of a second naval nuclear fuel facility to support the Navy's nuclear fleet. I agree that our nuclear-powered warships are too important to the defense of this country to depend on only one source for nuclear fuel.

I am also pleased that you selected the Savannah River site for this facility. The Savannah River plant has a long record of outstanding performance in nuclear materials production and is certainly well qualified to do the job.

I shall be pleased to cooperate with you in any way I can.

Admiral **Rickover**. Thank you, Senator Thurmond. I believe the Savannah River site chose itself for this project. It is the best place for the job. So I deserve no particular credit, except for having the perspicacity to go to that place.

I also want to thank you, Senator, for all that you have done for this program and for me, ever since the beginning of the program. Without your support we would not be where we are today.

Senator **Warner**. Senator Exon?

Senator **Exon**. Admiral, I want to join my colleagues in welcoming you back before our committee once again.

As you know, I am a relatively new member of this committee. I endorse the salute and accolades that have been given to you by my colleagues with whom you have worked for many years in the critical development of our Navy nuclear forces. I salute you once again for your leadership in this area.

I have not had a chance to look at your proposal.

I have two basic questions, if I might, to start out, Mr. Chairman.

You think you need $15 million to get started. What do you estimate the total construction cost will be?

Admiral **Rickover**. The rough estimate is about $300 million. However, I hope to do it for less.

ENVIRONMENT AND RADIATION

Senator **Exon**. Since you have been a leader in this program, there are those of us who are also concerned about what in the world are we going to do with not only our military nuclear waste but also our civilian nuclear waste as well. Have you addressed this in your prepared testimony at all?

Admiral **Rickover**. My prepared statement includes as appendices two annual reports associated with radiological aspects of the naval nuclear propulsion program. One deals with occupational radiation exposure and the second with environmental monitoring and the disposal of radioactive wastes. We have addressed these issues and we are handling them.

As a measure of what we have done, the average lifetime occupational radiation exposure for people in the naval nuclear propulsion program is less than what they receive from natural background and medical radiation. So we are very careful about radiation. We are also carefully handling the radioactive waste material. There are designated facilities for placing waste, and we use those. Also, we have had no nuclear accident in the entire history of this program.

Senator Exon. I am familiar with that, and I suspect that a great deal of that has been the care and diligence that you have exercised as the overseer of this program.

Admiral Rickover. Yes, sir, it takes extreme care and diligence to assure we do not have an accident or over-expose a single one of the many thousands of people who have been in this program on ships and shore. This is, of course, the most important thing.

Senator Exon. I have no further questions, Mr. Chairman. Thank you.

EXTENDING CORE LIFETIME

Admiral Rickover. There is one other point I would like to make. I mentioned it before your colleagues came in, but I am working now to design a nuclear core that will last for the life of a ship, as presently estimated by the Navy, so that when the ship is built and fueled, that is the end of it. I think you should know that.

Certainly you, Senator Stennis, with all the experience you have had with the military during your career, know the significance of that in wartime, when you have a ship that does not have to be refueled. It does not depend on logistical support for fuel supply.

Also, referring to the issue you raised about waste, Senator Exon, when we started this program, we figured the cores would only last for a year, and they lasted for 2½. We have progressively increased lifetimes to 10 to 15 years, and are aiming for 30 years. By doing so, we drastically reduce the amount of nuclear waste. Generally, when you make an improvement, it has a tangential effect in other aspects. The same thing is true here.

Senator Warner. Senator Stennis?

Senator Stennis. Thank you, Mr. Chairman.

Admiral Rickover, no Member of the Senate is more indebted to you or to anyone else than I am to your wise counsel over the years. You woke me up here again 2 or 3 years ago when I was holding hearings of an Appropriations Subcommittee that carried the money for research with reference to energy and additional sources and improvement of old sources. You were so careful—you always are—in stating that problem and something of the enormity of what we were going to have to do to meet it, the cost involved and everything like that. It was quite revealing to me.

At some point, you know, we realize things. I asked you what we would do if we made you czar for 1 day in the Government on all this problem of energy. You said you would make it a felony for anyone to use natural gas for fuel.

Admiral Rickover. That is correct, sir. I still adhere to that viewpoint.

Senator Stennis. That is a fine summary. That was a kind of anchor for me to hold to in the storm that has been blowing back and forth.

Now, you have touched on so many things that I won't attempt to make a review of them.

Here is another experience I had with you while I was chairman of the committee. You asked me when you were a witness if I had read so and so from your pen, a booklet that you had put out; and I said that I had received it but I had put it aside for special reading and have not read it yet. You said, "Well, how are you going to keep well informed unless you read what I write?"

Instead of resenting that. I took it seriously and took heart and that is a good summary of the situation, gentlemen. You have to read what this man writes and says, or you are behind.

I am trying to compliment you now. I am going to pass it on, if you don't mind. I know time is precious here, otherwise you would not have called this meeting at 8:30.

Senator WARNER. Mr. Chairman, put it right on the record, go ahead.

Senator STENNIS. That is all right. I am going to listen closely to what he says and read what he writes.

Admiral RICKOVER. Thank you, Senator.

TRIDENT FUNDING

Senator WARNER. Admiral, let us go back to sea for a minute.

This subcommittee, as you may know, recommended to the full committee, and the full committee accepted the recommendation, that we defer until 1983 the full funding for this 10th Trident submarine, in view of the construction difficulties that have been experienced in connection with building this class of ship.

We provided the Department of the Navy with that level of funding which, in our judgment, would enable the Department to keep this ship on the projected schedule. We added $75 million in additional long-lead funding to protect against delay in delivery of the major components; and also we provided money for the 11th in long lead.

I would like to have your views with respect to the action of the committee so that I may refer to those observations when this matter is raised on the floor in the Senate.

Admiral RICKOVER. I thoroughly agree with your action, sir. It is quite adequate.

Senator WARNER. In your judgment, are there any negative aspects to the national defense of our country of this action by the committee?

Admiral RICKOVER. No, sir. You know, there is such a thing as overkill. All of us, even those in the Defense Department, must bear that in mind. We must bear in mind that what is desirable from one viewpoint is not necessarily always desirable from the viewpoint of the entire country, and we in the military must also be careful and consider the taxpayer.

What you did is perfectly satisfactory as far as I am concerned. Of course, I cannot speak for others, but I think in this area I am probably as familiar with the issue as anyone else in the Navy.

Senator WARNER. Therefore, it was a prudent management action and should not in any way be a detraction from our overall defense load or the potential cost of the boat?

Admiral RICKOVER. Yes, sir, it is a good action.

Senator WARNER. Unless the members of the subcommittee have other questions, it is the intention of the Chair to go into executive session at this time. To those in attendance desiring to continue to follow this hearing this morning, we will resume in open session in another 15 or 20 minutes, so that if you wish to rejoin us, feel free to do so.

We will go into executive session at this time.

Admiral RICKOVER. Before you close, may I say a few words about a very fine gentleman who has devoted his life to the defense of the country, the distinguished Senator who is sitting at your left, Senator Stennis?

I have known him for many, many years. First, he is the perfect gentleman from a personal standpoint. He is what everybody thinks a Senator ought to be. Furthermore, he has helped me tremendously at a time when the going was hard.

I am sorry that there are not more members of the committee here to hear what I have to say—what a fine gentleman, what a fine patriot he has been and continues to be.

All of us are deeply grateful to you, sir.

Senator WARNER. Admiral, we thank you.

Senator STENNIS. Thank you very much. I appreciate those comments.

Senator WARNER. I share those views. Throughout my over a dozen years in this area, where I have had him as an adviser, it is a privilege for me to sit here with him. We still refer to him as "the Chairman" and believe me, that comes from the depths of our hearts.

Senator STENNIS. Thank you, Senator.

Senator WARNER. We will go into executive session at this time.

I ask counsel to inform the Chair as to the persons present in this room having the required clearance.

[Whereupon, at 9:05 a.m., the subcommittee proceeded into executive session.]

EXECUTIVE SESSION

Senator WARNER. It is important that this record contain your views as the United States continues to witness an ever-increasing Soviet submarine capability. Would you give us your viewpoint with respect to our current program for the building of submarines, in comparison to that of the Soviets, whether we in the Congress are providing adequate direction and funding, or where we should be going?

THE SOVIET NAVAL THREAT

Admiral RICKOVER. I mentioned earlier, Mr. Chairman, there is such a thing as overkill. I do not believe that it is necessary for us to match any potential enemy weapon for weapon. I think the cost would be ruinous.

There comes a time, with the great potency of weapons, that you can overdo things. I would like to tell you my general philosophical attitude: I think it is not a proper premise to constantly react. I remember many years ago—I believe it was in testimony to the House Appropriations Committee—when I said, if the Russians were to announce they were about to send a man to hell, lots of people in this country would urge that we beat them to it.

I think there is some of that attitude today. There is a word, "sufficiency," and I think that is a valid word. You can overkill. You don't have to match the other person. He has a different system of government; his government consists of about 14 people in the Politburo who can make all the decisions for the country.

Our system does not anywhere near lend itself to that. We have to have consensus; we have to consider the individual taxpayer who pores over his income tax; and we have to be reasonable.

So, in my opinion, we should be very careful that we do not burden our taxpayers too much—I would even add "unnecessarily."

This may sound like anathema, coming from a military man, but I am a citizen first and a military man second.

[Deleted.]

Again, I repeat, I do not want to overextend this country in what I consider to be an unnecessary manner. I am very conscious of that.

OTHER RESEARCH AND DEVELOPMENT

Senator WARNER. Other than the extension of the core life, are there any other major R. & D. projects that you are contemplating that we should be going into?

Admiral RICKOVER. I do not anticipate changing from the present pressurized water reactor plant we are using. We are constantly improving the reliability and the life of our reactor plants. [Deleted.] We spend a great deal of time and energy on making them reliable. Once they put to sea, they can operate anywhere in the world without hindrance; they have so done. Our nuclear submarines are probably as reliable as any other warships in the world.

[Deleted.] So, I have to see to it that the ships are reliable enough and that the people are trained enough to operate in that manner.

Senator WARNER. Thank you very much.

Chairman Stennis?

Senator STENNIS. I have nothing further. Thank you.

Senator WARNER. Senator Exon?

Senator EXON. Thank you, Mr. Chairman.

Admiral, I hope we are on record now, because I think it is important that we get your views——

Senator WARNER. I don't think we have gone off the record, but we will allow the admiral an opportunity to go off the record.

Senator EXON. Did you want to go off the record before I ask my questions?

Admiral RICKOVER. Would you mind if I revise for the record some of the remarks I made in the last few minutes?

Senator WARNER. You indicated a desire to be off the record. As we examine the transcript, if there are portions where it was your intent to be off the record——

Admiral RICKOVER. If I have your permission, I would like to look at the record to insure I didn't use classified information that would harm this country if it got into the wrong hands.

Senator WARNER. You asked for the option to go off the record.

Admiral RICKOVER. I won't need to if this is a classified session, sir.

Senator WARNER. It is classified.

NAVAL STRENGTH

Senator EXON. Let me explore two things with you and the general overview of the Navy. This British rating system you are familiar with; a recent estimate indicated that the Soviet Union was, or would be, markedly ahead of the United States and its allies on overall naval strength.

How much credence do you place in that? You are familiar with the rating system I am talking about?

Admiral **Rickover**. I am, sir.

Senator **Warner**. For the purpose of the record, are you referring to "Janes Fighting Ships"?

Senator **Exon**. Yes.

Senator **Warner**. I think that is privately owned and not affiliated with the British Government.

Senator **Exon**. No; it is privately owned.

Admiral **Rickover**. Their statements are probably accurate, [deleted]. I mentioned earlier that there is such a thing as overkill. If you have a type of government where a small number of people run the whole thing and there is no electorate, you can do anything you want. It is quite appealing in a case like that to have a superabundance of power.

But power can't get you everything. You know, sometimes even morality is stronger than power.

I again refer to the word, "sufficiency." There is only so much you can do before you overdo it.

As I mentioned earlier, I would not feel right in just coming here with the confidence you have in me and using that confidence to try to scare you, that you have to do this and you have to do that. I don't believe in that.

When I talk to the members of this committee, or any committee of Congress, I consider myself sitting right where you are, with the problems you face and with your responsibility to the electorate. I always think that way.

Senator **Exon**. Is it safe then to say that you are not particularly concerned with the rather dire predictions that were made on overall naval strength by this British private company?

Admiral **Rickover**. No, sir, I am not.

MANPOWER

Senator **Exon**. Thank you.

You hit on something I wanted to ask you about, to get your views on, because I am on the Manpower Subcommittee of this important committee and I have some concerns about where we are going or not going on overall manpower.

[Deleted] you said something to the effect of having the properly trained manpower to do the job?

Admiral **Rickover**. Yes, sir.

Senator **Exon**. Are you concerned about the strength of the manpower in the Navy today, and particularly in the areas of the senior noncommissioned officers in the Army and their counterparts in the Navy?

Admiral **Rickover**. Let me talk about the Navy, sir, because I am more familiar with it. I am not concerned about the type of people I have on nuclear ships. I pay no attention to race, religion, or color. The man who can do the job gets that job, and that is absolutely essential for a military organization if the country is going to fight for its life. I make no distinction.

If the man can do the job, I accept him. I know of no other way of running a military organization. The country depends on its military organization; it spends untold wealth on it; therefore, it has to make sure that anyone who has a job in it can do his job regardless of any other considerations.

I do not believe that the military should be a vehicle for correcting social injustices at the expense of obtaining quality people. There are other means for doing that.

Senator EXON. Admiral, maybe I should limit this to nuclear ships with which you are familiar, but I consider you an expert on the overall Navy as well. Let me specifically ask about the nuclear ships with which you are most familiar.

Are you satisfied with the present engineers, the petty officers, the lower ranking officers who are operating in the force, that you have the most expertise in, and if you are satisfied, are you confident that we are now bringing people along who are going to take the place of those who will be retiring or otherwise leaving the service?

Admiral RICKOVER. Sir, if I weren't satisfied with the people serving in the nuclear-powered ships, they wouldn't be on those ships; that is the simple answer to your question.

As I mentioned earlier, I am legally responsible for the safety of the reactors in these ships. In that capacity I see to it that they operate properly and that the people are well trained. This is my responsibility. So you need have no concern that I am not getting what I want with respect to the quality of the people.

NAVAL ACADEMY AND NROTC EDUCATION AND TRAINING

What I am not getting is adequate support from the Navy in taking in all the naval officers for nuclear power training that I should from the Naval Academy and from the Naval Reserve Officers Training Corps program in the universities. Regardless of the source, every officer in the nuclear Navy has been personally interviewed by me and accepted by me. There is no nuclear trained officer on any nuclear-powered ship whom I have not personally interviewed and accepted. That is all I can say about it.

Senator EXON. Therefore, I assume you are saying that you are also satisfied with the petty officers who are in your particular branch?

Admiral RICKOVER. Yes, sir; we train our people. I much prefer to get people who have had no prior naval experience. I do not want transfers from other branches of the service. They have already learned too many wrong things. So, I want to get and train my own people.

This is the way the naval nuclear propulsion program has worked and this is one reason why it operates so well.

Senator EXON. Then to sum up, as far as you are concerned the all-volunteer service has not fallen short of either the quality or the quantity of people who are involved in your particular service?

Admiral RICKOVER. That is correct in regard to quality, sir. However, as I previously stated, the Navy has not been able to obtain sufficient numbers of officers for the nuclear power program, and there has also been difficulty in retaining the highly trained nuclear operators, both officers and enlisted, after their obligated service has been completed. Recent monetary incentives authorized by Congress may improve the situation in regard to retention. Regardless of that, you can rest assured as long as I am in charge we are going to have qualified people to handle the nuclear reactors and nuclear-powered ships.

If I don't, I am going to come back here and tell you; but I don't think that is going to be necessary.

Senator EXON. Thank you, sir.

Senator WARNER. Admiral Rickover, we thank you. We understand you now have to proceed to the House of Representatives for further testimony. We appreciate your appearance this morning. I think we have put together a fine record.

I am hopeful that this committee will grant your full request for $15 million.

Admiral RICKOVER. Thank you very much, sir.

Again, I would like to thank the other Members. You have been more than generous to me. It is one of the big things in my life, that I have had so many friends here.

Thank you, sir.

Senator STENNIS. We appreciate what you have done.

Senator WARNER. The committee will now take a short recess.

[A short recess was taken.]

Senator WARNER. The Subcommittee on Strategic and Theater Nuclear Forces will resume its hearing in closed session on the necessity to continue to support our nuclear weapons program nationwide.

We have as a panel this morning, first, Dr. Morgan Sparks, Director, Sandia National Laboratories—and Mr. Chairman, and members of the committee will take note that this may well be Dr. Sparks' last appearance before this committee; we also have Dr. Roger E. Batzel, Director of the Lawrence Livermore National Laboratory; and in place of Dr. Donald M. Kerr, we have his deputy, Dr. C. Paul Robinson, on behalf of the Los Alamos National Laboratory.

Gentlemen, Senator Jackson and I would suggest that you each lead off and give your statements, and then we will turn to questions.

Dr. Sparks, would you kindly lead off first?

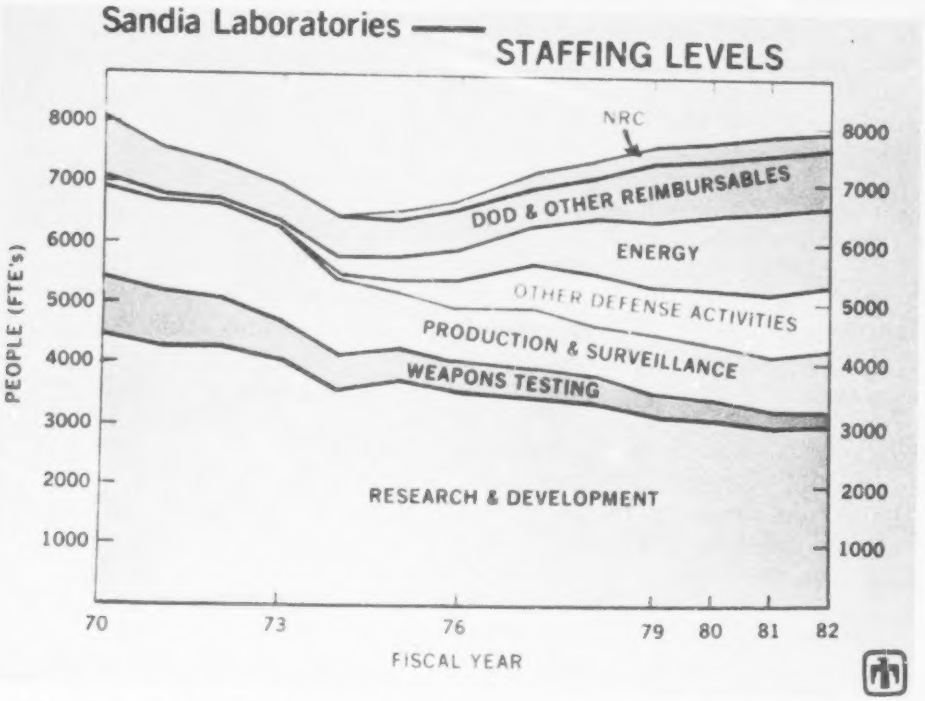
STATEMENT OF MORGAN SPARKS, PH. D., PRESIDENT, SANDIA NATIONAL LABORATORIES

Dr. SPARKS. Thank you, Senator Warner.

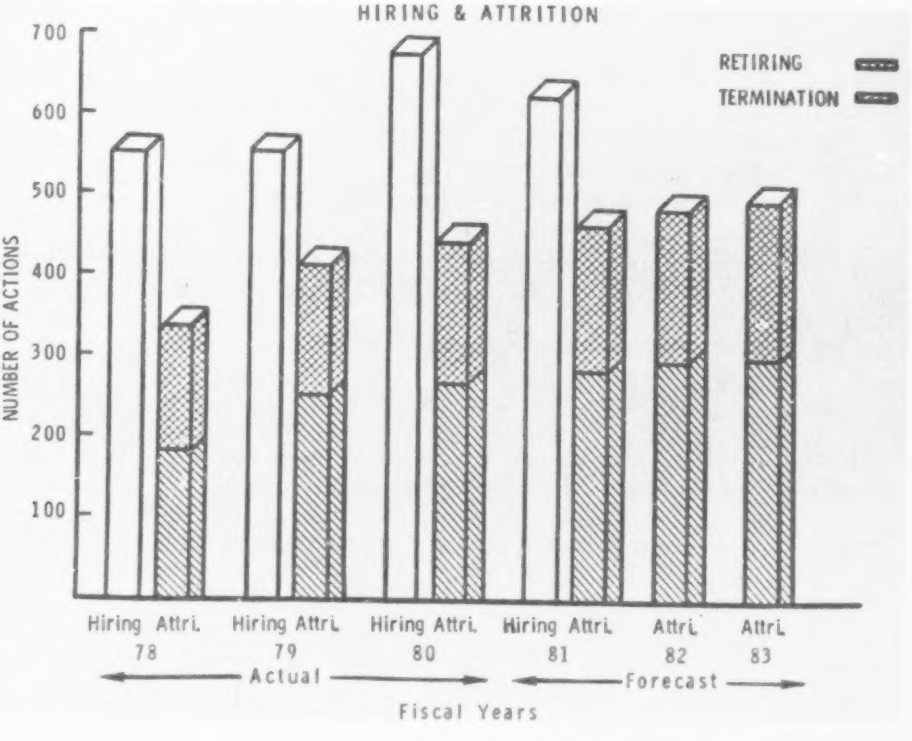
GENERAL OBSERVATIONS ABOUT SANDIA

First, I would like to give you some general impressions about Sandia. Our staffing level is in step with our workload. We now have about 2,500 fully professional/technical members of the staff. Our recent experience in recruiting the kinds of people we need has been good. We have had a 75- to 80-percent acceptance rate in the field, where competition is stiff.

Our total personnel for the past few years is shown in this first viewgraph.

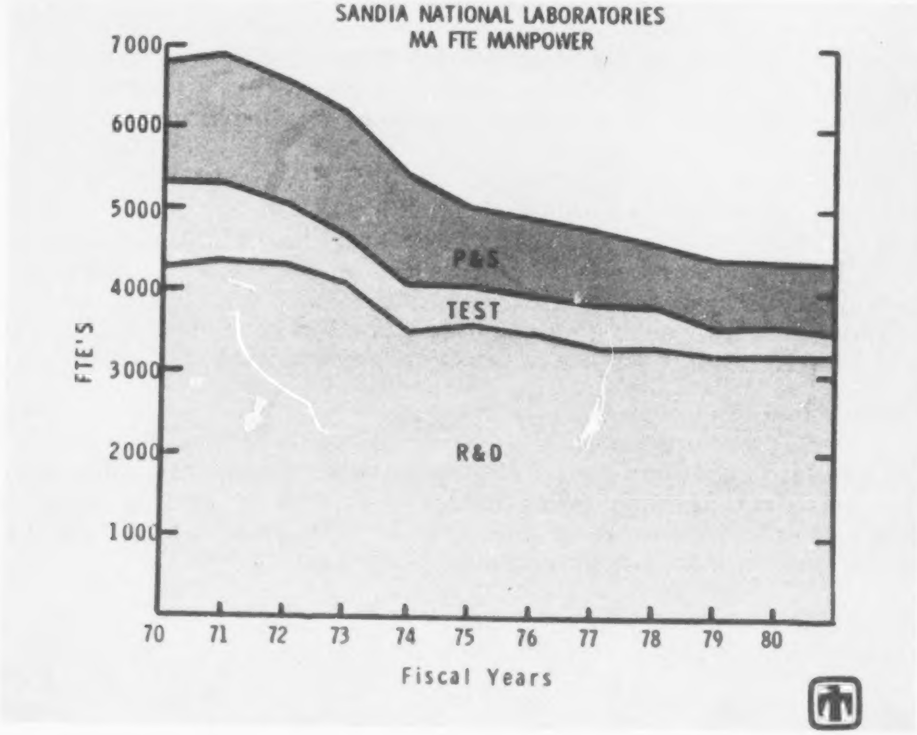


If you will look at the top line, we have been growing at a modest rate for some half dozen years and we are leveling off. The next viewgraph shows our hiring activity and also the personnel attrition rate for the past few years, and a projection for the years just ahead.



The bar chart on the left, the one without any hatching, is the hiring we have done each year, and the hatched area shows the attrition for all reasons. With the total enrollment figure for the laboratory now about 8,000, the expected annual attrition of roughly 500 people per year will give us a turnover rate of a little more than 6 percent, a rate we consider both manageable and desirable.

Please recall that over the past decade there has been a marked reduction in the manpower we have assigned to weapons work in Sandia. That is shown in the next viewgraph.



In 1970, nearly 7,000 employees were funded by Military Application, and in that year we had seven weapon systems under development, which is our first priority. By 1979, the number of weapon-program employees had shrunk to about 4,200, where it remains now. We had 11 developmental programs active in 1980. During that decade, our weapons development generally satisfied military requirements and proceeded on schedule.

The way in which that was accomplished leads to one of my major concerns. During the first half of the 1970's, the pressures to meet schedules for programs under development forced us to shortchange our advanced research and development. During the second half of the decade, when it became clear that weapon R. & D. funding would continue to decline and equally apparent that long-term neglect of advanced R. & D. would be perilous, we rebalanced our program to spread the risks more equitably.

Despite the care we took in that balancing of risk, we now see problems in our development programs because our advanced R. & D. failed to provide alternatives or the necessary insights to resolve problems as they arose. [Deleted.]

I would like to underline the importance of advanced R. & D. by pointing out that current U.S. nuclear weapons contain ideas that were generated many years ago. In a world that grows ever more threatening, it is essential that we not allow the ideas that will support the future weapon systems to be strangled today by lack of support.

Fortunately for all of us, it now appears that we will see an increase in manpower for weapons work in fiscal year 1982, allowing us to reduce overall risks through an increase in advanced R. & D. This upturn is timely and I hope represents only the first step in that direction.

ADVANCED DEVELOPMENT

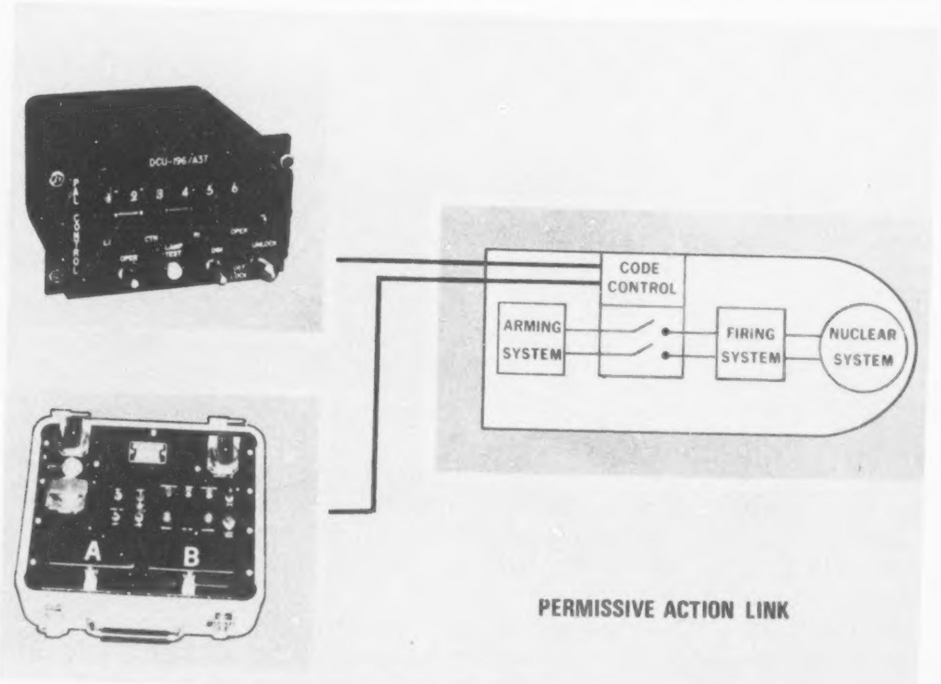
Advanced development work is vital to our future in several ways: It provides a reservoir of ideas and technology that allows us to respond to new requirements and to unusual problems that may arise during systems development.

These new ways of upgrading the quality, the safety, and the reliability of weapons often guide us to new methods of designing and manufacturing weapons at less cost. Very importantly, advanced work helps keep our staff technically challenged and is fundamental to ability to attract outstanding technical talent.

Today, we are working on about 30 advanced development projects and I have selected just two to illustrate the importance of this work:

IMPROVED PAL

The first is the improved PAL—permissive action link. This concept facilitates the control of nuclear weapons by incorporating a coded switch in the arming line, and this idea has been around for a long time; it is shown schematically in the viewgraph.



PERMISSIVE ACTION LINK

Originally, there was one code and one release message, so the process of periodically recoding the PAL switches was straightforward. To provide greater flexibility and security, we now have multiple-code coded switches which, thanks to modern electronics are much smaller than the old, single-code switches, but the process of recoding switches now requires more time and more people.

We have been developing new encryption techniques [deleted] and we use these techniques with new microelectronic logic units to reduce significantly the time and number of people required for recoding the PAL switches.

The goal of the effort is convenient PAL-code management which restricts neither the implementation of the multiple-release codes nor weapon deployment. As a result of our advanced work, we see the promise of significant improvement in the near future.

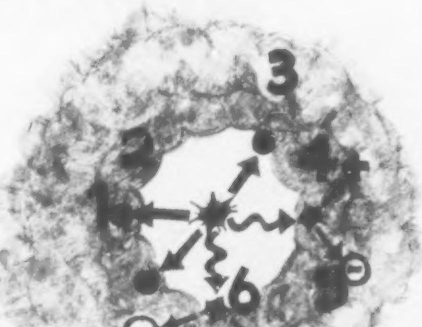
Another example of advanced work is in our analysis and simulation of nuclear weapon effects.

ANALYSIS AND SIMULATION OF NUCLEAR WEAPON EFFECTS

The implementation of the ABM Treaty several years ago made it less important that our reentry bodies and their warheads be able to withstand the effects of enemy nuclear bursts, so we drastically reduced our efforts to understand and simulate nuclear weapon effects. In view of the recently renewed interest in ABM's, it now becomes important that we put renewed emphasis on this work, which covers several complex problems.

Principal Outputs of a
Nuclear-Weapon Burst

Output
1. neutrons
2. gamma rays
3. x-rays
4. alpha particles
5. beta particles
6. weapon debris



To illustrate, this viewgraph shows the output of a weapon. These effects not only vary greatly with different types of weapons, but they also all interact with surrounding materials, including the air and the ground and, finally, the target. I even found some of our understanding of the weapon effects unrelated to ABM's is inadequate. For instance, we need to improve our understanding of coupling of nuclear explosions to the ground. This is important to hardening of our own installations and also to the fuzing of our reentry bodies, which affects our ability to destroy hardened enemy installations.

Regarding the simulation of weapon effects, we continue to develop machines which more accurately simulate the neutron, X-ray, and gamma ray pulses in the laboratory by making the length and magnitude of the effects pulses more realistic and by designing machines with larger volumes, thus permitting exposure of large components and subsystems.

These new machines are important in saving both time and money. The better the laboratory simulation, the less we need to resort to underground testing. In the event of a test ban, simulation would become even more important.

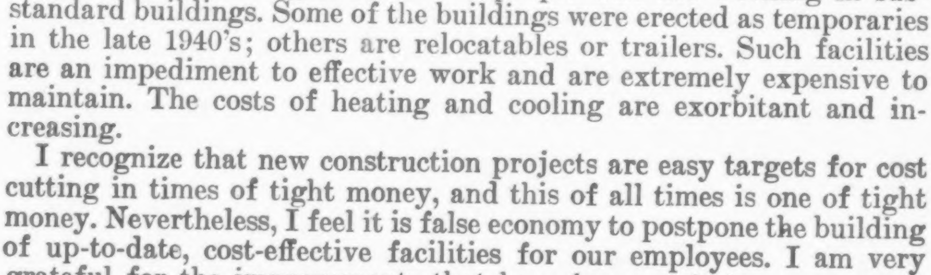
FACILITIES

Turning now to our facilities, which is another area of my concern, and I am referring to physical facilities, we and the other weapons laboratories have large numbers of people who are working in substandard buildings. Some of the buildings were erected as temporaries in the late 1940's; others are relocatables or trailers. Such facilities are an impediment to effective work and are extremely expensive to maintain. The costs of heating and cooling are exorbitant and increasing.

I recognize that new construction projects are easy targets for cost cutting in times of tight money, and this of all times is one of tight money. Nevertheless, I feel it is false economy to postpone the building of up-to-date, cost-effective facilities for our employees. I am very grateful for the improvements that have been made in recent years and I certainly do not want to wear out my welcome with this committee, but much remains to be done.

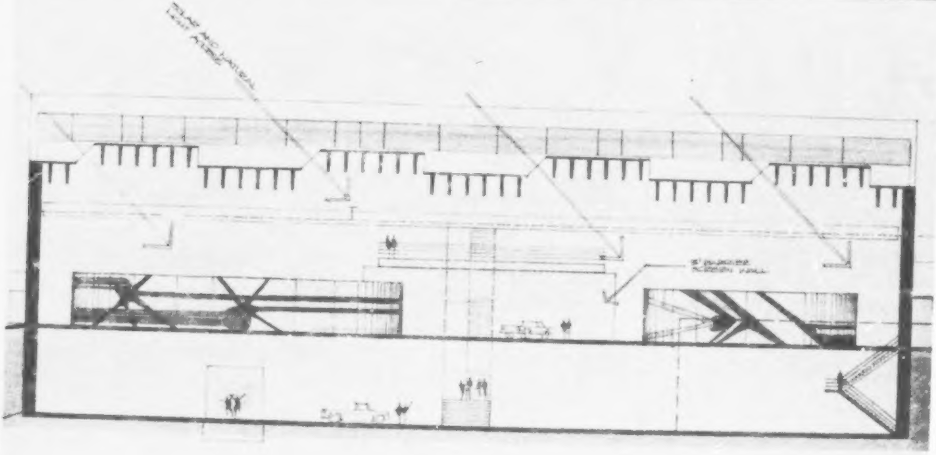
In view of the fact that 30 percent of our employees are engaged in energy research and development, we are also seeking support from DOE's Director of Energy Research for a $20 million Energy Technology Laboratory.

REACTOR SUPPORT FACILITY
OFFICE/LIGHT LABORATORY-BLDG 960



Regarding facilities for the weapons program, we are very pleased to see the reactor support facility shown in this viewgraph authorized in the fiscal year 1981 budget and we hope the rest of the funds for it will be appropriated this year. This building will provide laboratory space and office space for about 150 people and relieve the somewhat hazardous overcrowding near our reactors and accelerators.

SIMULATION TECHNOLOGY LABORATORY (West View)

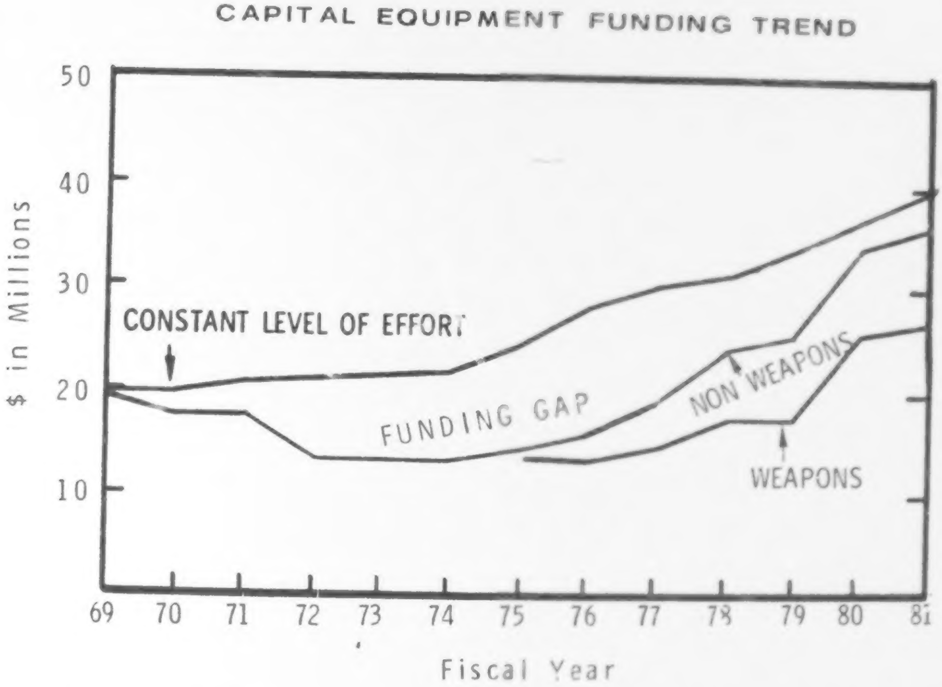


I described our advanced work in weapons effects simulation. The important next step is what we have called the simulation technology laboratory shown in this viewgraph, a facility which will improve substantially our X-ray and gamma ray simulation. The total estimated cost of this facility is $39.2 million. We are developing the technology for this facility with $2.6 million in operating funds in fiscal year 1981 and we are planning to continue at a level of about $6 million in fiscal year 1982, but our urgent need is for $1.2 million in construction funds for design work in fiscal year 1982.

CAPITAL EQUIPMENT

Now, in the area of capital equipment, I worry about the state of that. This equipment is vital in the successful operation of the modern laboratory.

Sandia
National
Laboratories



This viewgraph shows on the top curve the number of dollars Sandia would have required over the past decade to have had reasonably modern equipment.

An equipment modernization program which was started in 1975 has begun to close the gap; however, much remains to be done, as you can see. With the cost of equipment rising as it is, we are in danger of falling seriously behind in our needs. These needs for buildings and equipment are part of a pattern that is plaguing American industry. While we have talented people, there is a limit to what they can accomplish without adequate tools, and we need your help in getting them.

Mr. Chairman, members of the committee, this concludes my statement. It has been an opportunity and a challenge to have been a partner, together with you, in a key national program and to meet with you each year to describe Sandia's role in it, and I thank you very much. I will be pleased to respond to any questions.

Senator WARNER. We will wait until the panel have made their opening statements. Thank you very much for a very thorough statement.

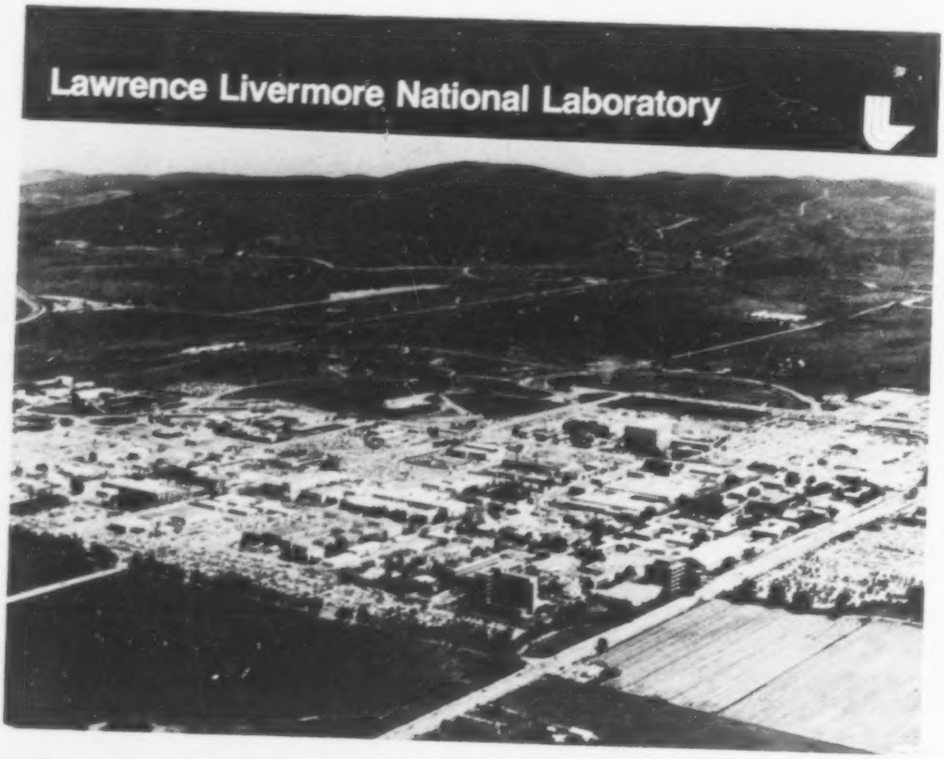
We will now hear from Dr. Roger E. Batzel.

STATEMENT OF ROGER E. BATZEL, PH. D., DIRECTOR, LAWRENCE LIVERMORE NATIONAL LABORATORY

Dr. **Batzel.** It is a pleasure to be here this morning, gentlemen.

GENERAL OBSERVATIONS ABOUT LAWRENCE LIVERMORE NATIONAL LABORATORY

What I want to spend most of my time doing this morning is talking about the question of support for the nuclear weapons research and development program.



This viewgraph is a layout of the Laboratory, which is about 40 miles southeast of San Francisco. We are located on a square mile. The facilities are federally owned and we have about 7,500 people there at the Laboratory, about 40 percent of whom work on the nuclear weapons research and development program. Approximately 15 percent of our effort is in magnetic fusion, another 15 percent in inertial confinement fusion, and the remaining 15 percent includes other smaller programs which involve, for example, advanced isotope separation, biomedical, and environmental research.

Again, the area I want to concentrate on is that related to the question of the level of support for the country's nuclear weapons research and development program.

THE NUCLEAR WEAPONS PROGRAM HAS TWO PRIMARY MISSIONS

- **Maintain a viable, modern nuclear stockpile.**
  - **Respond to DOD requests for new weapon systems.**
  - **Maintain current stockpile.**
- **Insure that our nuclear weapons expertise is second to none.**
  - **Improve our understanding of weapon physics.**
  - **Explore advanced nuclear weapons concepts.**
  - **Understand what is possible.**

This viewgraph just restates my view of the Laboratory's responsibility to the country in nuclear weapons research and development; namely, to maintain a viable, modern nuclear stockpile.

Another issue which I think is extremely important is that we want to insure that our nuclear weapon expertise is second to none. That means that we are going to have to expand our effort in trying to improve our understanding of basic weapons physics. In that process, we have to look at the question of advanced nuclear weapons concepts. We have a major responsibility to know what is possible in nuclear weapons technology so that we don't find ourselves embarrassed by developments elsewhere in the world.

LLNL WEAPONS PROGRAM

	Fiscal year—	
	1970	1980
People	4,900	2,700.
Tests (devices)	[Deleted]	
Advanced concepts	Balanced	Imbalanced.
Supporting research	do	Do.

Ten years ago—and this follows the same pattern as Dr. Sparks' discussion—the Laboratory had about 4,900 people involved in nuclear weapons research and development. We had [deleted] tests at the Nevada test site involving [deleted] devices. We did multiple devices associated with a single test. We were balanced in terms of our efforts on advanced concepts and with respect to supporting research.

Today we have about 2,700 people in this area. We will conduct approximately [deleted] tests, at the Nevada test site. These two areas are of significant concern to me—the general level of support and the general level of experimentation.

The Nevada test site is the experimental laboratory for the weapons laboratories.

We are doing far too little in terms of advanced concepts.

Supporting research has taken a back seat to our making sure we meet our current weapons commitments to the Armed Forces.

LLNL HAS 5 WEAPONS PROGRAMS IN THE DEVELOPMENT PHASE

Warhead	Description	Initial operational capability
W70-4	Lance [deleted]	[Deleted.]
W79	8-in artillery shell, [deleted]	
W82	155-mm artillery shell [deleted]	
B83	Advanced strategic bomb	
W84	Ground-launched cruise missile	
MX	High yield enhanced safety warhead for MX	
MK500	Maneuvering reentry vehicle for Poseidon and Trident	

WEAPON DEVELOPMENT

Just to remind you of the weapon systems under development at the Lawrence Livermore Laboratory, this is a listing. As you can see, we have a significant commitment to the Department of Defense for provision of warheads for nuclear systems. This level of effort is higher than we have seen historically and that level of commitment, coupled with a decrease in people and opportunity for experimentation, means that we are meeting those commitments at the expense of our advanced research and development, and that, I think, is an imbalance that we can't afford to continue to live with.

We are pleased to see a turnaround in terms of support, and we really need to continue that level of expansion over the next 2 or 3 years, to build back to a level which, I think, will give us a viable nuclear weapons research and development program.

I am sure this applies to all three laboratories, not to just Livermore.

Senator EXON. Mr. Chairman?

Senator WARNER. Senator Exon?

Senator EXON. Are we in open session?

Senator WARNER. No. We are in executive session now.

Senator EXON. I saw that was secret.

Senator WARNER. I appreciate your bringing that to my attention. Counsel has advised me that we are in closed session and the room has been cleared of those who do not have the proper clearances.

Senator EXON. Thank you.

PRIME AREAS FOR EXPLORATION

Enhanced safety and security designs.
Classes of high yield designs.
[Deleted.]
Tailored effects.

ADVANCED DEVELOPMENTS

Dr. BATZEL. The areas which I believe deserve increased effort are: enhanced safety and security designs, new classes of high-yield nuclear weapon designs that we have not been able to pursue, and [deleted] tailored effects. The issue of tailored effects has to do with providing flexibility; for example, the enhanced radiation weapons which we have provides flexibility for the country.

Enhanced safety and security is an important area—making sure that in the case of an accident involving a nuclear explosive the high explosive doesn't detonate and spread plutonium. With respect to this issue, we are in a position to provide warheads which will remove most of one's worries about plutonium dispersal as a possibility; but we do need to modify the stockpile and make sure that the right decisions are made with respect to warheads provided for future systems.

[Deleted.]

Senator WARNER. Is the previous chart classified?

Dr. BATZEL. Yes, it is secret. It is up in the corner. [Deleted.]

Again, the status is proof of principle from a physics point of view, with the expectation—and, I think, a reasonable expectation—that given the resources to pursue this technology, we will have a significant capability established.

[Deleted.]

Just to remind you of what the Soviets are doing, that is the test comparison for the United States and the Soviet Union in the last several years. The Soviets over the last 2 or 3 years have conducted approximately [deleted] of experiments that we have. That, to me, is a worry.

When one looks at what kinds of tests the Soviets are doing, [deleted]. Couple that test program with what one sees in their weapon laboratories which continue to grow and I think we have no basis for feeling comfortable about our position in the weapons research and development area and no basis for feeling that we have an edge in that area.

LLNL NEEDS

[Deleted] tests per Laboratory.
R.D. & T. manpower growth.
Provide major Laboratory facilities.

RESOURCE REQUIREMENTS

This is my summation on the nuclear weapons research and development program needs for Livermore. I think, again, it reflects the needs of the other laboratories. The two weapons research laboratories need approximately [deleted] tests per year to have what we would consider an adequate test program. As we understand it, the fiscal year 1982 budget will allow us approximately [deleted] tests. We would like to build to a level of about [deleted].

We need a continued growth in the R.D.T. & E. manpower and, to echo Morgan Sparks' comments, we really do need facilities for our people. We need the modern facilities that we have not acquired over the last 10 years.

ICF AT LLNL

ICF at LLNL is important to weapons work.

Broadens base of weapons program: Code development; diagnostics; and training.

Nova provides a Laboratory facility for thermonuclear weapons research.

INERTIAL CONFINEMENT FUSION

I want to say a word about the inertial confinement fusion program. It is an important area to our weapons-related efforts. It uses a technology which is based on nuclear weapons, physics, and understanding; it provides a crew of people who can help on our weapons efforts and they have and continue to do so.

[Deleted.]

SPECIAL ISOTOPE SEPARATION/LLNL

Uranium (LIS) separation is moving well.
[Deleted.]
[Deleted.] Pu available for upgrading.

Confident—with proper resources—process can be put onstream, in place to produce by about 1987.

SPECIAL ISOTOPE SEPARATION

Finally, I want to say a word about the special isotope separation. That is the cleanup of plutonium. One has the problem, if one wants to use [deleted] plutonium, of taking out the unwanted plutonium isotopes 240 and 241, leaving the PU 239, which is the active material used in our nuclear weapons.

We believe we have in hand the technology which will allow the cleanup of plutonium and make available to the system additional [deleted] material. Plutonium is a material which is going to be in short supply for the weapons program over the next several years.

That completes my testimony for this morning. Thank you.

Senator WARNER. Thank you very much, Dr. Batzel, for a very informative—and quite alarming—report.

We will now hear from Mr. Robinson of Los Alamos National Laboratory.

STATEMENT OF C. PAUL ROBINSON, PH. D., ASSOCIATE DIRECTOR FOR NATIONAL SECURITY PROGRAMS, LOS ALAMOS NATIONAL LABORATORY, LOS ALAMOS, N. MEX.

Dr. ROBINSON. Senator, I bring apologies this morning from Donald Kerr, the laboratory director, who is unable to be here today due to a previous commitment involving his driving interest over the last year in the question of ballistic missile defense.

He is at the Georgetown Center for Strategic and International Studies, leading a symposium on that topic. I am sure that we will hear more of this topic in the future, and one of the major needs in this Nation's defense is to find some technology appropriate to defending ourselves against ballistic missiles.

GENERAL OBSERVATIONS ABOUT LANL

The Laboratory today devotes approximately 50 percent of its efforts to defense programs through the Department of Energy's budget, and another 4 percent of the total effort to direct work in support of the Department of Defense.

This past year I took over responsibilities for those efforts, the nuclear weapons research, development and test, and the Department of Defense programs.

I think the work at Los Alamos continues to be of the highest quality. Nuclear weapons still provide the first-line defense of this country. I believe the Nation will have to rely on these weapons for the foreseeable future as well.

The Laboratory in devoting its resources has begun to wonder over the last few years about the adequacy of the overall defense mission. We have worries particularly founded on two bases, that we have had declining resources, as well as additional constraints, such as the constraints on testing with the 150-kiloton upper yield limit and the lower number of overall tests that we were able to carry out.

At the same time, we have been aware that the breadth and level of technology that is being pursued in the Soviet Union may well be surpassing that of the United States in a large majority of areas.

To echo some of the statements of Dr. Batzel, we more and more often find ourselves not being the innovators in a particular technology area, but when we recognize an outstanding idea we find that it has been published earlier and investigated in Soviet literature.

We believe it is imperative that the Nation embark on a rejuvenation of the defense science and technology assets. It is very important that we start applying our resources more to the long-term, high-risk technologies which we have necessarily largely ignored over the past decade.

In nuclear weapons research, our initiatives have been largely devoted to refinements of nuclear weapons—How can one reduce the overall cost of a nuclear system? How can one provide for reduced manning of the weapons while they are in stockpile in the services, and how to reduce the amount of special nuclear materials required in the weapons, since we project a major shortfall in that area for about a decade?

Finally, we have been working in a very important area, the area of improved safety of the weapon systems themselves, both with some of the work that Dr. Sparks and his people have been doing in permissive action links in control of the weapons and the investigation by the weapons laboratories of insensitive high explosives, an explosive that does not detonate should a weapon be involved in a fire and also will not detonate from small arms fired into the system.

We believe in the next decade it is very important that the weapons program broaden its horizons, first of all to examine the vulnerability of all of our strategic weapons deterrents, looking carefully at the aspects of scientific advancements which are contemplated in the near future which could endanger those weapons [deleted].

We have identified a number of future technology areas for the laboratory which include a continuing investigation of pure fusion devices for weaponry, [deleted] a number of concepts of defensive strategic weapons.

I would like now to give you a brief overview of the work of the last year and point out some of the highlights of our achievements.

RECENT ACHIEVEMENTS OF THE LANL

During a 23-month period ending during the last quarter of 1979, we brought four major weapon systems into the production complex. The first of these is the W–78 warhead for Minuteman III. The next is two modifications of the B–61 bomb. These are devices which can be used either in free-fall, contact burst mode, or parachute-retarded lay-down bomb. It has become a workhorse device employed in all the services.

Finally, the W–80, which is a common nuclear warhead for both the air-launched and the sea-launched cruise missile.

The first slide [chart deleted] I would like to show is an interesting test that was conducted this past January, [deleted].

The event was named the baseball shot.[Deleted.]

The shot was detonated on January 15 of this year. It gave a nuclear yield of [deleted] underground, which was exactly as predicted.

[Deleted.]

Next let me turn to a unique device that was developed during the past several years. [Chart deleted.] It is an alternate warhead for Pershing II, our W–85.

This one is called the W-86. It has the unique feature of being an earth-penetrating nuclear warhead. The very difficult development requirements on the system were successfully met, especially on the part of Sandia and by our laboratory.

This device burrows through approximately [deleted] in the ground on reentry, and taking acceleration loads of [deleted] both loading and unloading, as it enters the ground, and a [deleted] force lateral load. Building this system, [deleted] has been one of the major recent challenges of weapon technology. Unless we really start to press the limits, and continually press the limits, I think the entire enterprise can become less than you or we expect of it.

The next area I would like to mention is a unique development associated with our nuclear test work.

This is a photograph [chart deleted] of the Nevada test site. You see the large runs of cable in preparation for putting a device down-hole. You will notice in the picture the orange cable, which goes to the left side and then enters the trailer at the top. You can see the orange cable entering at this end, and look at the enormous number of black electrical cables coming out of the other end. This is fiber optic cable. These orange devices are the glass fibers which are starting to be used in a number of areas of modern technology.

The phone company, for example, is investigating its use instead of electrical conductors. We found its use to be quite a panacea in Nevada. We have achieved better data resolution on the performance of nuclear tests than we were able to achieve previously and, surprisingly, overall system cost is less than the electrical cable which we had been using in the past.

[Deleted.]

You see the large inner vessel, the containment vessel, 2-inch steel. The device in white, which is above the man kneeling, is lowered down into the vessel. The space between the primary explosive system is filled with christmas tree ornament balls.

In looking at a number of shot mitigating species, we determined these to be a very cheap but very workable material.

The explosives detonated were about [deleted] of high explosive. We mitigate the shock and use up the energy in fracturing those bulbs and contain all the material inside the inner vessel. We provide the blue outer vessel as well for backup safety, though to date we have had no breach of the inner vessel and think we have established the system as a very useful local test.

The next slide [chart deleted] shows the action following that. [Deleted.]

NUCLEAR TESTING

I am very pleased with the administration's decision to augment the test program in the coming year. The program was approved last November 12 by the Carter administration and if the present administration and Congress provide the funding, we believe we can approximately [deleted] of Nevada tests.

The critical issues for increasing this activity are, first of all, skilled manpower, equipment, and then facilities. We are beginning our recruiting efforts in hopes of beginning this program as rapidly as possible to increase the level of tests and, in fact, rejuvenate the entire weapons program.

VERIFICATION TECHNOLOGY

Another area of major concern of the laboratory and especially of our director, Don Kerr, has to do with treaty verification as it relates to nuclear matters.

[Deleted.]

NONNUCLEAR INITIATIVES

There are a number of areas of the laboratory concerned with new initiatives, in direct strategic defense areas, other than nuclear weapons. In particular, we have programs involving nonnuclear ordnance, armor penetrators using some of the technology from the nuclear weapons program. We have had success this past year when a small explosive system about the size of your fist was able to penetrate [deleted] armor plate, [deleted]. We think there are a number of areas of this technology that are applicable in the nonnuclear area. We hope to enhance those efforts over the next few years.

We additionally have activities in space power, [deleted] and particle beams, and we have undertaken a small effort at the request of the Army to look at chemical and biological warfare defense. This is an area that has lagged from lack of injection of technology; it has been to a large extent devoid of high-technology approaches [deleted].

CAPITAL EQUIPMENT AND FACILITIES

Finally, let me say a few words about capital equipment and facilities.

The capital equipment situation has become somewhat better by the restoration program which was inaugurated 2 years ago; however, in this area we have particularly felt the pinch of inflation. If we looked at where the laboratory was in 1970 for its budget in capital equipment and just inflated that with the Bureau of Labor Statistics index, only in the proposed fiscal year 1982 budget would we finally match up to that curve and be equal to where we were in 1970 if inflation is taken into account.

However, the deficit which has been produced over a little more than a decade amounts to more than $30 million, so there is still a need to rejuvenate the equipment capability within the laboratories.

Similarly, at Los Alamos we have a critical need of facilities. Other than the new plutonium facility at Los Alamos, the most recent major construction was in 1962, for the Phermex facility, and most of the major weapons facilities date from the early 1950's. Many of these facilities do not meet today's safety requirements and I think are in need of replacement, and in a fairly timely way.

The facility area is one of the crucial problems I find in taking over the weapons program.

I think that will conclude my remarks at this time. Thank you very much.

Senator **WARNER**. Senator Jackson?

NUCLEAR EFFECTS—ELECTROMAGNETIC PULSE (EMP)

Senator **Jackson**. Dr. Sparks, are we learning anything new on EMP?

Dr. **Sparks**. We have not done any serious studies on EMP in recent years. We know a great deal about EMP. That is a major problem in any nuclear exchange. We have all kinds of problems of that sort, the effect of one nuclear weapon on another. I think that is an area that needs strengthening.

Senator **Jackson**. It seems to me that it is one that we really need to do a lot more work on. I assume we have been following it—of course we have, through the years—since just 30 years ago at Eniwetok where we discovered it. I was out there at the time when the tests were run.

Dr. **Sparks**. I don't want to leave you with the impression that we have not done anything. I mean, in terms of understanding the effects, there have been no big experiments of that kind.

One of the things we have done at Sandia is to develop a process for modern microelectronics which increases the radiation resistance of the electronic components so that they would be less vulnerable to things like EMP.

Senator **Warner**. If the Senator will yield—you used the term, "we." I presume that is restricted to your laboratory, because the R. & D. subcommittee last year—I specifically recall—urged that we continue EMP funding, along with the test bed of the B-1.

Dr. **Sparks**. There is a large facility in Albuquerque, run by the Air Force, a project called Trestle, where they study the effects of stimulated EMP on large airplanes.

Senator **Warner**. You have access to that information?

Dr. **Sparks**. Yes; certainly.

Senator **Warner**. Somewhere in our overall scientific complex we are continuing on it?

Dr. **Sparks**. Yes; I understood Senator Jackson's question to be directed toward nuclear explosions producing EMP.

Senator **Jackson**. Your main responsibility is the impact of EMP on the weapons; you don't get into all the other areas, such as communications?

Dr. **Sparks**. That is right. We don't directly, although we have a great deal of interaction with other parts of the system. We have had some interactions with the telephone company, for example, in the last year or two, in terms of the effect of EMP on communications.

Senator **Jackson**. Of course, that is one of the major concerns in the event of a surprise attack knocking out all communications, so-called secure communications. We really don't have hard, tough answers to those questions, do we?

Dr. **Sparks**. I think that is correct.

MX WARHEAD

Senator **Jackson**. Dr. Batzel, we are working on a different warhead now for MX. You mentioned that?

Dr. **Batzel**. There are alternative warheads being explored for MX. There is the MK 12A, the new Minuteman III warhead, and as an alternative, we have been doing developmental work on the so-called advanced ballistic reentry vehicle warhead which includes insensitive high explosive, has higher yield, and is somewhat heavier, as an option for MX. The ABRV warhead provides additional safety in case of an accident, but it would require additional investment of resources to bring it along to the same level as the MK 12A.

Senator JACKSON. How much would it increase the yield, roughly, over the MK 12A?

Dr. BATZEL. The MK 12A is [deleted]. The ABRV is [deleted]. The weight difference—the MK 12A, as I recall, is about [deleted] and the weight of the ABRV is [deleted]. I am pretty sure of those numbers.

SOVIET COMPLIANCE WITH THE TTBT

Senator JACKSON. Speaking of the Soviet Union ground tests, Dr. Batzel, their yields, if you read just the newspaper accounts, seem to have gone beyond the understanding that we have, or the treaty that we have on overall yield?

Dr. BATZEL. The problem that we always have in verification of yields is the uncertainty in the yield measurement, because we have to depend on interpretation of a seismic signal in terms of yield of explosive. That process is uncertain to at least [deleted].

When one looks at the yield and the midpoint is [deleted] and it is my understanding that some of the Soviet yield measurements come out that way, one can come to the conclusion that the Soviets are stretching the limit of the threshold test ban treaty. Whether they have or not is hard to know because of the uncertainty in yield measurement.

Senator JACKSON. I have seen newspaper accounts of Swedish reports where they have put the figure up pretty high. I don't know how competent they are on detection, but I assume they have some pretty good seismic people.

Dr. BATZEL. If the quoted yield is [deleted] it certainly could be [deleted] within that regime you are not sure what the yield actually is.

Senator JACKSON. So, the whole monitoring business is really inadequate; is it not? I mean, when you have that wide a range in which you depend on detection systems, as contrasted with onsite capability, that is where it breaks down?

Dr. BATZEL. That is where it breaks down; that is correct.

Senator JACKSON. And it is not effective. That ought to be our lesson in dealing with this question of underground tests. The ability to violate the agreement based on current technology is quite apparent?

Dr. BATZEL. It is quite apparent. It would be important to have the flexibility of testing some of our new weapons at their full yield, [deleted].

GLCM WARHEAD (W-84)

Senator JACKSON. What is the status of the warhead for the ground-launched cruise missile?

Dr. BATZEL. We are right on schedule. This warhead includes advanced security; it includes also the insensitive HE which protects it against accident. [Deleted.]

We are going to be conducting [deleted] but we believe we are in the final phases of the test program associated with development of that warhead. It looks good.

Senator **Jackson**. Are you satisfied with the safety features?

Dr. **Batzel**. Yes.

Senator **Jackson**. This system will be deployed primarily in Western Europe if we are able to get together with our allies. [Deleted.] That is why I asked the question.

Of course, for all three—ALCM's and SLCM's as well as GLCM's—all should have the obvious safety features; [deleted]. That is why I especially am anxious to get from you your judgment regarding safety.

Dr. **Batzel**. We have included in this warhead the insensitive HE, which buys you a larger margin with respect to any accidental detonation of the warhead.

Even if the propellant were to ignite and detonate, that high explosive won't go off.

In terms of safety in a fire, we have included what we call a fire-resistant [deleted].

So, from a safety point of view, I think we have taken the actions which provide the best technology we have available in the weapons complex system at this juncture; and I think it is excellent.

ALCM AND SLCM WARHEAD (W–80)

Senator **Jackson**. Dr. Robinson, how are we doing on the ALCM and the SLCM warheads?

Dr. **Robinson**. [Deleted] we were exactly on schedule with the weapon development program and with the production plans.

We are doing a number of things right now to try not to lose that schedule.

[Deleted.]

We have looked at that through the production cycle. I believe we can meet the initial operational capability, IOC, for that system by either of those paths.

[Deleted.]

Dr. **Robinson**. The explosives are totally different in these devices. We have not, as of yet, built a strategic warhead with these insensitive high explosives, mainly because of the weight. The MX is the first system we are considering putting the insensitive high explosive on. It is a standard explosive which has been in most of our systems.

[Deleted.]

Senator **Warner**. Senator Exon?

Senator **Exon**. Thank you, Mr. Chairman.

[Deleted.]

Dr. **Batzel**. Yes.

Senator **Exon**. May I explore some other areas, Mr. Chairman?

Senator **Warner**. Yes, indeed.

TITAN INCIDENT AT DAMASCUS, ARK.

Senator **Exon**. I would like to ask each member of the panel if they were surprised or not at the fact that the warhead blew out of the Titan silo in Arkansas and was thrown about 100 yards? Were you surprised that we didn't have more difficulties there than we had? Why didn't that warhead go off?

Dr. **Batzel**. Go ahead; it was your warhead.

Dr. ROBINSON. Yes, it was a Los Alamos warhead. Having seen the photographs of the site and the enormous amount of energy that was released by the propellant explosion, we, as well as most of the participants in that, were quite surprised that anything was left intact. There was, in particular, a 750-ton door that blew more than 700 feet from the site. Pieces of concrete half the size of this room were launched as well. The warhead survived amazingly intact.

The nuclear system was distorted in a number of ways, but all the components were there localized in one spot. The system had standard HE, what is, in a relative sense, more sensitive HE, but it did not explode which I think is a testament to some of the care that had been given in the selection of those systems.

The particular accident there was the first accident in more than a decade of major consequence involving a nuclear system. It was an all uranium system rather than one that would have spread plutonium as our two previous major accidents at Palormares (Spain) and Greenland.

I think we are very pleased that it did stay together as well as it did.

Senator EXON. We all are.

Dr. ROBINSON. I am not sure if one can attribute that primarily to good design or some of the unique conditions when it was blown out. It was quite a complicated accident.

Senator WARNER. What was the risk factor of it exploding? On a scale of 1 to 10, where were we?

Dr. ROBINSON. For a nuclear yield?

Senator WARNER. Nuclear yield.

Dr. ROBINSON. For nuclear yield, our estimates are something below one in a million for such a thing going off with any kind of nuclear yield above 4 pounds.

Senator WARNER. What about the HE then?

Dr. ROBINSON. The high explosive going off is again the most likely consequence. Fire did not envelop the warhead at any particular time. When pressure built up deep in the silo, it blew off the door, launched the warhead, breaking off most of the case. Of all the missile, there are only small fragments of aluminum left scattered around the site. The impact in the landing of the nuclear device as well as some of the additional shock it experienced during flight—there were more air explosions while it was in free flight, about 330 feet—were not sufficient in shock strength to detonate the explosive.

Senator EXON. What would you say was the chance of that happening on a scale of 1 to 10?

Dr. ROBINSON. I think there would have been a rather significant probability that it could have detonated under the right shock conditions. As you know, with our plane crash in Greenland, the high explosive did go to high order and scattered plutonium in that particular incident. It did not in this case. I think we were somewhat lucky that the high explosive did not go off. I stress in this unique case there is no plutonium in that warhead, so the accident situation would not have been very great.

Senator EXON. As a layman in this area it is inconceivable that we could have something like that happen because a man dropped a wrench. It seems inconceivable to me that we didn't have more safety built into that system than that. Does it concern you?

Dr. Robinson. It does concern me. We spend a great amount of our time and always have in the weapon development cycle imagining scenarios and trying to build in protection against them. Indeed the Air Force in the missile system allowed for this with a number of nets to catch things. The particular socket that was being used was undersized to be caught in those nets, resulting in this rather unique accident.

Senator Exon. Mr. Chairman, if I could go to another area.

STOCKPILE IMPROVEMENT

Dr. Batzel. [Deleted.]

I personally think safety is a very important issue for the weapons complex. I think we are up to the task of doing something about it.

Dr. Sparks. I would like to comment on safety. That was the principal message that I had last year when I talked to this committee. I think it should have come from the discussions so far that nuclear weapons are safe. We have never had an unintentional nuclear explosion. But as to safety, there is nothing absolute. Safer than what? The point is that we now know how to make nuclear weapons a lot safer than we did in the past. As Dr. Robinson mentioned in his testimony, through 1967, 1968, something like that, we were replacing systems so rapidly that they never were in stockpile very long. That situation has changed tremendously now.

In addition, many of the early designs were intended to be in storage for a long time and not be involved in transport. Whereas, quite a bit of the operations now do move nuclear weapons around. So, the modernization program that we would be capable of would include the things you have heard of, insensitive high explosive, includes things in the electrical parts of the weapons which enable the explosion to take place, that we now know how to design so that we have predictable responses in abnormal environments such as fuel fires and crashes.

Now we are not talking about things to be done in the laboratories. These things have all been done in the laboratories and the problem is to get those new developments into the deployed stockpile. Some planning is such that many of the older weapons will be there well into the 1990's. So it behooves us, I think, to try to make sensible judgments about which one of these older weapons should be brought up to current capability of even safer design concepts. It is ironic that we have had a capability existing in the production complex for some years now where we really haven't been manufacturing very many weapons and the problem has been to keep that complex alive. Those years would have been an ideal time to perform these modernizations. Now I think more people are beginning to become convinced that modernization is important to do and it is going to compete in the total capability of the weapons complex with the new systems coming along.

UNEXPLAINED INCIDENT IN THE SOUTH ATLANTIC

Senator Exon. Dr. Robinson, you brought up the matter which you thought was critically important. I believe we have better intelligence information and surveillance of possible nuclear explosions. You mentioned the incident in South Africa. Since I assume you know quite a little more about this than I do, what is your personal view as to what happened down there? Was it a flash of light or was it something else?

Dr. ROBINSON. It is probably a question we are not going to be able to answer conclusively. [Deleted.] I think that without confirmatory data from several sensors, it will be politically impossible for the Nation to make a charge in an international forum that could be proven one way or another, which is why we stress the need that we must enlarge and rejuvenate the entire detection capability.

We got warnings relatively late to take action following the flash of light that we did not secure radioactive samples, samples of air which we could analyze for radioactivity. It would be the so-called smoking gun of a nuclear test. If you can capture some of that smoke, that is the proof positive. We do not have that in this incident. Hence, we cannot tell you definitively that it was a nuclear test.

Senator EXON. Our whole defense system is based on our ability to detect a Soviet launch, whether or not it is going to be aimed at the United States. If we can't tell what happend in South Africa, how confident are we that we would know whether the Soviets have actually launched or not? Is there any rationale to my concern?

Dr. ROBINSON. Yes, but there is an answer to that. We have concentrated our instrumentation of all types in the Northern Hemisphere because of worry on exactly the possibility you stated. Hence we have had very little attention in the Southern Hemisphere and it was merely by accident that we had a particular device looking at that area of the South Atlantic at that time.

Senator EXON. So, the answer is that had South Africa been targeted, we could have been sure what happened there.

Dr. ROBINSON. That is right. [Deleted.]

Senator EXON. One last question I would like to get into, something that Dr. Batzel touched on in some detail with some slides, [deleted]. Is that correct?

Dr. BATZEL. That is correct.

Senator EXON. [Deleted.]

Dr. BATZEL. Yes.

Senator EXON. [Deleted.]

Dr. BATZEL. [Deleted.]

Senator EXON. I understand. Do we have any indication, you touched on it briefly but didn't get into any details, as to where the Soviets are or anything like that?

Dr. BATZEL. We follow the Soviet literature, the unclassified literature. [Deleted.]

Senator EXON. They don't ordinarily publish things like that, do they?

Dr. BATZEL. They have a habit of publishing little tidbits in various areas in the unclassified literature. We find it a good window into some of the Soviet——

Senator EXON. What they might be thinking?

Dr. BATZEL. It gives you some feeling about what they could well be working on.

Senator EXON. Gentlemen, thank you very much. You have been very informative and helpful. Thank you Mr. Chairman.

Senator WARNER. Senator, I thank you for a fine line of questioning. The Chair and both counsel for the majority and minority are going to ask the Department of Energy to take custody of this record.

It may well be that we will have to attach a higher classification than what the Chair stated at the time the hearings started. We have touched on very sensitive areas here.

ARMS CONTROL

Before parting with this panel, I would like to have any observations that you may wish to provide with respect to the subject of arms control. I personally subscribe to the theory that we should try, in parallel with our efforts to increase America's defenses and its inherent capability in strategic weapons, to seek arms control, and here your views are important.

Would you care to lead off in this area, Dr. Sparks?

Dr. SPARKS. [Deleted.]

Senator WARNER. I hope that you find in your next career, whatever that may be, time to reflect and enjoy life. You have earned it.

We will take a brief recess now.

[A brief recess was taken.]

Senator WARNER. The subcommittee will resume its hearings now with Dr. Wade and Mr. Morgan. As I understand, this record is transmitted to your office for appropriate classification.

Mr. MORGAN. We will be happy to do that.

Senator WARNER. Mr. Morgan, will you lead off?

STATEMENT OF ROBERT L. MORGAN, ACTING ASSISTANT SECRETARY OF ENERGY FOR DEFENSE PROGRAMS; JAMES W. CULPEPPER, ACTING PRINCIPAL DEPUTY ASSISTANT SECRETARY OF ENERGY FOR DEFENSE PROGRAMS; AND DR. JAMES P. WADE, JR., ASSISTANT TO THE SECRETARY OF DEFENSE FOR ATOMIC ENERGY

Mr. MORGAN. It is my pleasure this morning to discuss atomic energy defense activities in our budget request for fiscal year 1982.

Our authorization request this year is for $4.996 billion. This is about $4.7 billion for the defense program activities and $300 million for the naval program.

CHART 1

ATOMIC ENERGY DEFENSE ACTIVITIES—BUDGET REQUEST

[BA dollar amounts in millions]

	Fiscal year 1981: Congressional—		Fiscal year 1982: Congressional—	
	Authorization	Appropriation	Authorization	Appropriation
Defense programs:				
Weapons activities	$2,422.3	$2,332.7	$3,070.2	$3,196.4
Inertial confinement fusion	(218.4)	(209.7)	(117.0)	(180.2)
Verification and control technology	39.4	39.5	50.0	50.0
Nuclear materials production	704.5	665.8	1,108.4	930.7
Nuclear material security and safeguards	46.7	47.2	48.0	48.0
Security investigations	15.0	15.5	23.6	23.6
Defense waste management	361.9	300.3	369.7	390.0
Subtotal, defense programs	3,589.8	3,401.0	4,669.9	4,638.7
Nuclear energy: Naval reactors development	398.4	303.4	326.5	361.5
Total, atomic energy defense activities	3,988.2	3,704.4	4,996.4	5,000.2

The fiscal year 1981 request shown here does include the fiscal year 1981 supplemental request that we have submitted for weapons testing. The defense activity request in fiscal year 1982 is approximately $1 billion, or 25 percent, over the fiscal year 1981 budget.

The increases are necessary to meet the near-term nuclear weapon stockpile memorandum requirements and also to continue initiatives for the vitality, stability and adequate capability of the defense program complex.

WEAPONS ACTIVITIES REQUEST

CHART 2

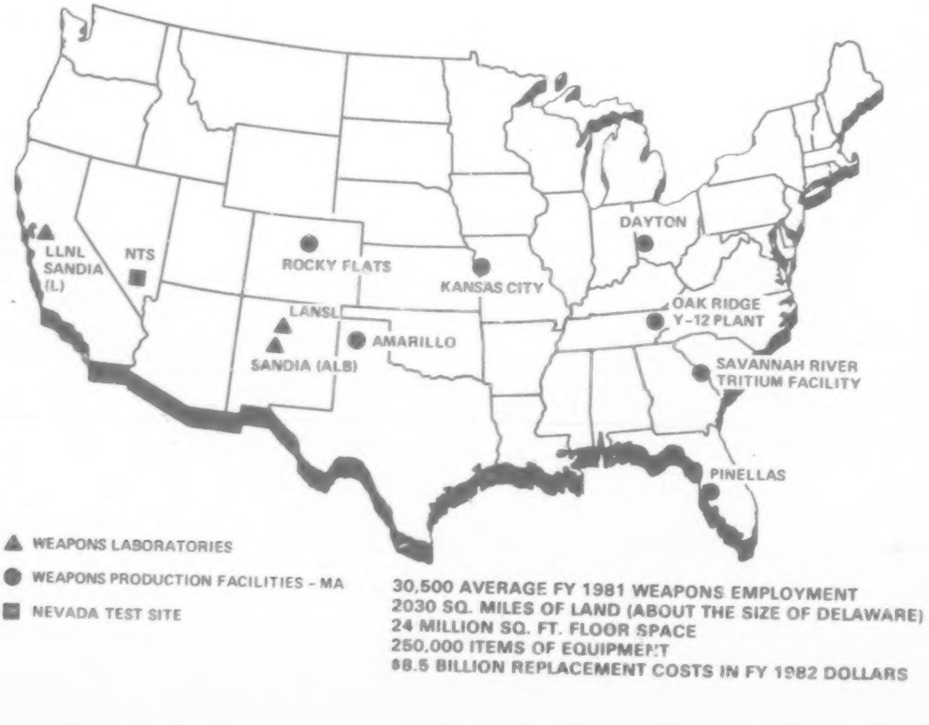
FISCAL YEAR 1982 WEAPONS BUDGET—AUTHORIZATION REQUEST

Item	Millions
Operating:	
Research, development, and testing	$955
Production and surveillance	1,352
Program direction	41
Total, operating	2,348
Construction	419
Equipment	186
Total, weapons program	2,953

In the weapons budget authorization request, the operating portion for R. D. & T. is approximately $1 billion; production and surveillance, $1.3 billion; and program direction is about $40 million, totaling about $2.3 billion. The equipment and construction request brings the total to $2.9 billion.

CHART 3

WEAPONS DEVELOPMENT, TESTING, AND PRODUCTION FACILITIES


LLNL
SANDIA (L)
NTS
ROCKY FLATS
KANSAS CITY
DAYTON
LANSL
AMARILLO
SANDIA (ALB)
OAK RIDGE Y-12 PLANT
SAVANNAH RIVER TRITIUM FACILITY
PINELLAS
▲ WEAPONS LABORATORIES
● WEAPONS PRODUCTION FACILITIES - MA
■ NEVADA TEST SITE
30,500 AVERAGE FY 1981 WEAPONS EMPLOYMENT
2030 SQ. MILES OF LAND (ABOUT THE SIZE OF DELAWARE)
24 MILLION SQ. FT. FLOOR SPACE
250,000 ITEMS OF EQUIPMENT
$8.5 BILLION REPLACEMENT COSTS IN FY 1982 DOLLARS

Now for a quick summary of the facilities we are talking about in the weapons development area:

The weapons laboratories are in California at Livermore, and in New Mexico at Sandia and Los Alamos. The nuclear test site is in Nevada, and then in addition, you see on this map the weapons production complex at Rocky Flats, Amarillo, Kansas City, Dayton, Oak Ridge, Savannah River, and Pinellas.

CHART 4

WEAPONS PROGRAM FUNDING—OPERATING

[BA dollar amounts in millions]

	Fiscal year—		
	1980	1981	1982
Research and development	$419	$507	$586
Testing	209	296	369
Production and surveillance	748	980	1,352
Program direction	35	41	41
Total	1,411	[1] 1,824	2,348

[1] Includes fiscal year 1981 supplemental of $41,000,000.

On the operating side, in explanation of the $2.3 billion I mentioned earlier, the research and development activities requirement is approximately $600 million; the testing program is about $400 million; and the production and surveillance activity is $1.3 billion.

CHART 5

FISCAL YEAR 1982 WEAPONS BUDGET—PRODUCTION AND SURVEILLANCE

[BA dollar amounts in millions]

	Fiscal year—	
	1981	1982
War reserve new production	$624	$864
Stockpile maintenance	73	99
Stockpile evaluation	99	120
Process development	61	72
Other costs	123	170
Risk factor		27
Total	980	1,352

Looking at the production and surveillance request, War Reserve new production requires $800 million; stockpile maintenance about $100 million; and stockpile evaluation will require about $120 million. Adding in process development, and other costs, the total is $1.3 billion.

Concerning weapon production deliveries, this chart [chart deleted] graphically shows where we are now, starting to climb the curve. The ordinate shows those deliveries that we have to put out the door to meet the nuclear weapons stockpile memorandum. This large, complex workload is why we believe the increases are appropriate and necessary to keep a viable program.

CHART 7

FISCAL YEAR 1982 WEAPONS BUDGET—RESEARCH, DEVELOPMENT, AND TESTING—OPERATING

[BA dollar amounts in millions]

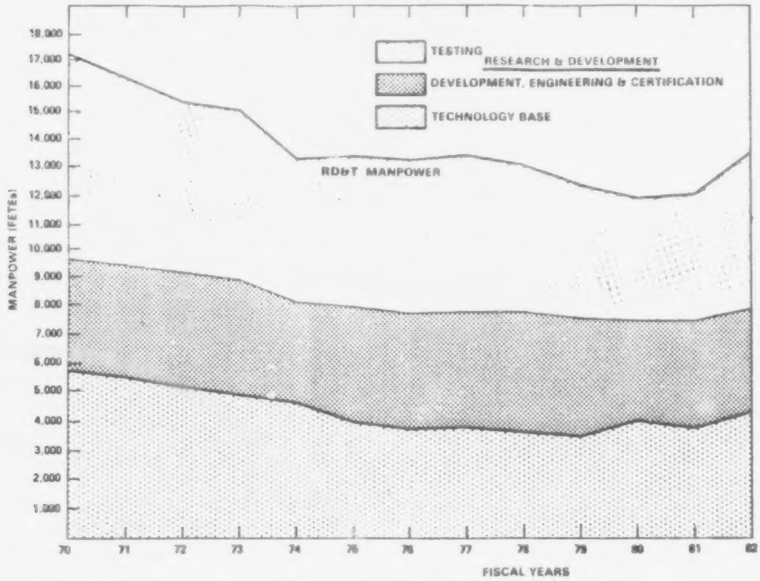
	Fiscal year—	
	1981 [1]	1982
Research and development	$507	$586
Testing	296	369
Total	803	955

[1] Includes supplemental which requests $41,000,000 operating funds. An additional $10,000,000 is requested in capital equipment.

In the research, development and testing area, the operating request for research and development is about $600 million, and the testing request is for a little less than $400 million.

CHART 8

DEPARTMENT OF ENERGY WEAPONS PROGRAM RD&T HISTORY — MANPOWER



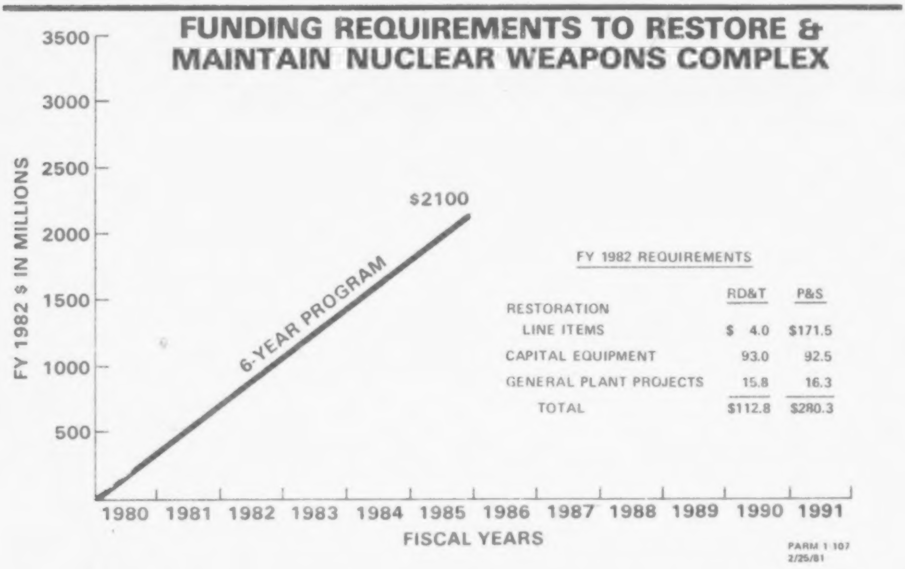
PARM:1-086
2/25/81

As you have heard earlier today, we are concerned about the manpower level engaged in research, development and testing activities. You can see there has been a steady decline over the past 10 years. In 1981 we are turning that decline around somewhat and we will be further increasing the manpower in 1982.

As the laboratory directors have mentioned, this emphasis on increasing R.D. & T. manpower needs to be continued over the next few years. We believe that we are turning the corner and, as you heard earlier, the laboratories are able to get the appropriately trained and qualified people.

I would like to show you a chart [chart deleted] on testing. [Deleted.]

Chart 10



FUNDING REQUIREMENTS TO RESTORE & MAINTAIN NUCLEAR WEAPONS COMPLEX

FY 1982 REQUIREMENTS

	RD&T	P&S
RESTORATION		
LINE ITEMS	$ 4.0	$171.5
CAPITAL EQUIPMENT	93.0	92.5
GENERAL PLANT PROJECTS	15.8	16.3
TOTAL	$112.8	$280.3

PARM 1 107
2/25/81

In addition, we are on a 6-year program to revitalize the weapons complex. We hope to spend approximately $2 billion over this 6-year period. We think this is necessary to maintain the production capability that is necessary in the out years

Chart 11

PRODUCTION COMPLEX

Need surge capability : [deleted].
No redundancy : Vulnerable to disruption of production.

We do need a surge capability [deleted] and we haven't any redundancy in our system. It is a single-phase system and if we have a problem at any one of our facilities, we do not have a duplicate, so that we have to look at doubling of some process lines, and we are trying to take care of that when we can during this restoration process.

CHART 12

CONSTRUCTION PROJECTS

[Dollar amounts in millions]

	Fiscal year 1982—		
	TEC	Authorization	Appropriation
PRODUCTION AND SURVEILLANCE			
Continuing projects		$170.0	$222.4
New projects:			
82-D-103, general plant projects, various locations	$16.3	16.3	16.3
82-D-104, new weapons production installations, various locations	5.0	5.0	5.0
82-D-106, weapon assembly facilities, Pantex plant	24.5	23.5	23.5
82-D-107, utilities and equipment restoration, replacement, and upgade, phase 3, various locations	626.0	87.5	87.5
82-D-108, nuclear weapons stockpile improvement, various locations	32.2	32.2	9.5
82-D-109, 155-mm artillery fired atomic projectile (AFAP) production facilities, various locations	53.0	35.0	35.0
82-D-111, interactive graphics system, various locations	30.6	9.0	9.0
82-D-146, weapons production and production support facilities, various locations	71.7	8.0	8.0
82-D-147, pressure test facility, Savannah River plant	3.5	3.5	3.5
Subtotal, production and surveillance		390.0	419.7
RESEARCH, DEVELOPMENT AND TESTING			
Continuing projects		10.0	43.3
New projects:			
82-D-100, general plant projects, various locations	15.8	15.8	15.8
82-D-142, North Las Vegas Atlas facility, NVO	3.6	3.6	3.6
Subtotal, research, development, and testing		29.4	62.7
Total, weapons program construction		419.4	482.4

Briefly, I would like to show you a list of the construction projects associated with that approximately $500 million in the next side.

CHART 13

OFFICE OF INERTIAL FUSION

Inertial fusion program goals: Determine the full potential of inertial fusion for applications to nuclear weapons [deleted] technology and to nuclear weapons effects simulation; determine the longer term potential of inertial fusion as an energy source.

INERTIAL FUSION

Very quickly, I would like to mention the inertial fusion program goals: to determine the full potential of inertial fusion for applications to weapons and to determine its potential as an energy source in the future.

CHART 14

FISCAL YEAR 1982 BUDGET SUMMARY

[Dollar amounts in millions, fiscal years]

	1981 budget authority	1982 requested authorization	1982 requested appropriation
Operating:			
IF	$139.2	$104.7	$104.7
Program direction	1.4	1.3	1.3
Total, operating	140.6	106.0	106.0
Equipment	12.6	11.0	11.0
Construction	56.5	0	63.2
Total	209.7	117.0	180.2

Note: In fiscal year 1981, $10,000,000 operating expenses will be deferred to fiscal year 1982.

The budget that we are proposing for inertial fusion is shown on this slide, and the total in the requested authorization is $117 million.

CHART 15

NUCLEAR MATERIALS PRODUCTION—FISCAL YEAR 1982 BUDGET REQUEST

[Total request, dollars amounts in millions, fiscal years]

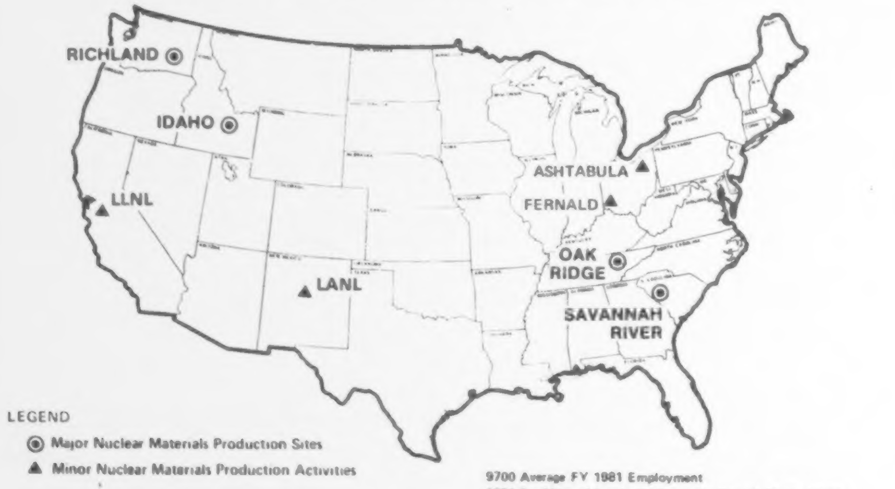
	1981 budget authorization	1982 request new authorization	1981 request B/A	1982 request B/A
Materials production	$703.2	$1,106.6	$664.4	$928.9
Program direction	1.3	1.8	1.3	1.8
Total	704.5	1,108.4	665.7	930.7

NUCLEAR MATERIALS PRODUCTION REQUEST

The nuclear materials production authorization request is approximately $1.1 billion. This is where we produce the tritium and plutonium for the weapons systems.

CHART 16

NUCLEAR MATERIALS PRODUCTION SITES


RICHLAND
IDAHO
LLNL
LANL
ASHTABULA
FERNALD
OAK RIDGE
SAVANNAH RIVER
LEGEND
◉ Major Nuclear Materials Production Sites
▲ Minor Nuclear Materials Production Activities

9700 Average FY 1981 Employment
1853 Sq. Miles of Land—1½ Times the Size of Rhode Island
$11 Billion—Escalated Acquisition Costs in FY 1982 Dollars

DP-0-630
3/13/81

The nuclear materials production sites are primarily located at Savannah River; Oak Ridge; Idaho Falls and Richland, Wash.; with support from Ashtabula and Fernald; and with some lesser activities at LANL and Livermore.

This chart [chart deleted] shows the nuclear materials required in plutonium equivalent to meet the weapon build requirements shown on the nuclear weapons production slide you saw earlier.

You will note [deleted] and utilizing that material in some of the new weapons. One of the items shown is the 8-inch artillery fired atomic projectile, a model of which you were looking at during the recess before this hearing, sir.

On this chart [chart deleted] you will see there is a supply line labeled three Savannah River reactors, and you can see that the demand curve, which is the dotted line, crosses the supply or availability line, so that we have had to begin some production initiatives to insure that the plutonium and tritium supplies needed to meet the weapon stockpile requirements are adequate.

CHART 19

NUCLEAR MATERIALS PRODUCTION—BUDGET SUMMARY

[Dollar amounts in millions, fiscal years]

		1982 request	
	1981 B/A	Authorization	B/A
Base	$536.9	$603.0	$620.5
New initiatives (fiscal year 1981):			
Restoration	26.0	150.6	81.0
L reactor upgrade	42.0	84.7	58.7
Increased PU production	10.0	20.8	20.8
Improved reactor safety	5.0	47.9	15.0
Special isotope separation	20.5	25.8	25.8
Purex/N reactor	22.3	76.3	74.6
Replacement production reactor	3.0	5.0	5.0
New initiatives (fiscal year 1982):			
Fluorinel facility startup		8.3	8.3
Idaho upgrade and replacement		43.0	17.0
Safeguards and security		43.0	4.0
Total	665.7	1,108.4	930.7

Of the new initiatives that we have begun in fiscal year 1981, one is in the restoration of the facilities at the material production sites, as we are doing at the weapon production sites. We have initiated the upgrade of the L reactor at Savannah River. [Deleted.]

Also underway is the startup of the Purex processing plant at Richland, and also operating the N reactor in a weapon-grade, rather than a fuel-grade mode.

Other new initiatives in fiscal year 1982 are the fluorinel facilities startup in Idaho, upgrading, and safeguards and security projects.

CHART 20

OPERATING EXPENSES

[Dollar amounts in millions, fiscal years]

	1981 budget B/A	1982 request new authorization and B/A
Operating:		
Reactor operations	$223.3	$280.6
Processing of nuclear materials	122.7	148.7
Special isotope separations research	13.8	21.8
Supporting services	97.5	163.3
Program direction	1.3	1.8
Total	458.6	616.2

Reactor operations take the major portion of the fiscal year 1982 operating amount, approximately $300 million; processing of materials after exposure in the reactors is about $150 million, and the other area is supporting services, as shown on this slide.

CHART 21

[Dollar amounts in millions, fiscal years]

	1981 budget authorization	1982 request authorization	1981 budget B/A	1982 request B/A
Construction	$183.4	$418.6	$160.0	$240.9

Construction activities—the request for authorization is approximately $400 million, and we do not have a slide here, but we can provide for the record what those projects are.

[The information follows:]

The following information for Materials Production's construction is supplied for the record:

CONSTRUCTION PROJECTS

[Dollar amounts in millions, fiscal years]

Projects	TEC	1982 authorization	1982 appropriation
Continuing projects		$135.4	$123.0
New projects:			
82-D-116, general plant projects, various locations	$23.0	23.0	23.0
82-D-117, plant engineering and design, various locations	3.0	3.0	3.0
82-D-118, N plant security and surveillance, RL	4.0	4.0	1.0
82-D-124, restoration of production capabilities, phase II, various locations	127.0	126.0	55.8
82-D-126, reactor safety and reliability, various locations	42.9	42.9	10.0
82-D-127, safeguards improvements, SR	36.0	34.6	2.0
82-D-128, plant perimeter security systems upgrade, ID	4.4	4.4	1.0
82-D-136, ID fuels processing facility, upgrade and replacement, phase I	40.0	40.0	14.0
81-D-126, pollution abatement facilities, RL	5.6	4.3	2.6
81-D-142, steam transfer header, SR	8.0	1.0	5.5
Total, materials production		418.6	240.9

CHART 22

DEFENSE NUCLEAR WASTE—BUDGET REQUEST

[Dollar amounts in millions, fiscal years]

	Fiscal year 1981: Congressional—		Fiscal year 1982: Congressional—	
	Authorization	Appropriation	Authorization	Appropriation
Interim waste operations	$215.5	$176.7	$266.2	$250.5
Long-term waste management technology	99.5	90.7	72.0	72.0
Terminal storage	34.0	20.0	12.7	48.7
Decontamination and decommissioning	4.1	4.1	10.3	10.3
Transportation R. & D	7.0	7.0	6.9	6.9
Program direction	1.8	1.8	1.6	1.6
Total	361.9	300.3	369.7	390.0

DEFENSE NUCLEAR WASTE

In the defense nuclear waste area, the authorization request is $369 million. This covers interim waste operations at all the production sites; it covers the long-term management technology aspects and there is some activity on terminal storage, decontamination and decommissioning and transportation.

CHART 23

VERIFICATION AND CONTROL TECHNOLOGY PROGRAM—FISCAL YEARS 1980–82 BUDGET HISTORY

[Dollar amounts in millions]

	1980	1981	1982
Operating expenses	$36.8	$38.7	$48.9
Capital equipment	1.1	.8	1.1
Total	37.9	39.5	50.0

VERIFICATION AND CONTROL TECHNOLOGY

International security affairs—for this program we are requesting approximately $50 million. This is the program where we are developing components to detect nuclear explosions which are in violation of test treaties.

SECURITY PROGRAMS

Our requests for security investigations and the nuclear material safeguards and security program are shown on this slide.

CHART 24

DEPARTMENT OF ENERGY DEFENSE PROGRAMS, SAFEGUARDS AND SECURITY, FISCAL YEAR 1982 AUTHORIZATION REQUEST

[In millions of dollars, fiscal years]

	Estimate 1981	Estimate 1982	1982 increase/decrease over 1981
Security investigations: Operating expenses	15.5	23.6	+8.1
Nuclear materials security and safeguards:			
Operating expenses [1]	43.8	44.3	+.5
Capital equipment	3.4	3.7	+.3
Subtotal, nuclear materials security and safeguards	47.2	48.0	+.8
Total, safeguards and security	62.7	71.6	+8.9

[1] Includes program direction of $4,200,000 in fiscal year 1981 and $4,000,000 in fiscal year 1982

This concludes my brief opening remarks. We have submitted to you my full text, if you would like to include it in the record, sir.

Senator WARNER. Thank you very much. Your statement in its entirety will be made a part of the record.

[Prepared statement of Mr. Morgan follows:]

PREPARED STATEMENT BY ROBERT L. MORGAN, ACTING ASSISTANT SECRETARY FOR DEFENSE PROGRAMS

INTRODUCTION

Mr. Chairman and members of the Committee, I am pleased to be here today to testify on behalf of the Department of Energy's (DOE) Fiscal Year 1982 budget request for those Atomic Energy Defense Activities under my cognizance as Acting Assistant Secretary for Defense Programs (ASDP). Those activities include nuclear weapons development and production, inertial confinement fusion, nuclear materials production, nuclear materials security and safeguards, security investigations, verification and control technology, and defense waste management.

In addition to these programs, the Department's Atomic Energy Defense Activities include the naval reactors development program which, of course, is under the direction of the Acting Assistant Secretary for Nuclear Energy (ASNE) and the Deputy Assistant Secretary for Naval Reactors, Admiral Rickover.

ATOMIC ENERGY DEFENSE ACTIVITIES, BUDGET REQUEST

[BA dollars in millions]

	Fiscal year 1981 Congressional—		Fiscal year 1982 Congressional—	
	Authorization	Appropriation	Authorization	Appropriation
Defense programs:				
Weapons activities	$2,422.3	$2,332.7	$3,070.2	$3,196.4
Inertial confinement fusion	(218.4)	(209.7)	(117.0)	(180.2)
Verification and control technology	34.9	39.5	50.0	50.0
Nuclear materials production	704.5	665.8	1,108.4	930.7
Nuclear material security and safeguards	46.7	47.2	48.0	48.0
Security investigations	15.0	15.5	23.6	23.6
Defense waste management	361.9	300.3	369.7	390.0
Subtotal defense programs	3,589.8	3,401.0	4,669.9	4,638.7
Nuclear energy: Naval reactors development	398.4	303.4	326.5	361.5
Total atomic energy defense activities	$3,988.2	$3,704.4	$4,996.[illegible]	$5,000.2

The Department's fiscal year 1982 budget authorization request is about $5 billion, as indicated on this chart. Of this amount, about $4.7 billion is for programs under the ASDP and about $300 million is under the ASNE.

The chart compares our fiscal year 1982 request for the ASDP programs with the fiscal year 1981 request, which includes a supplemental of $51 million for weapons activities. Overall, the administration's authorization request for Defense Activities represents an increase of $1.0 billion or about 25 percent over fiscal year 1981.

This increase is necessary to meet the near term weapons development and production requirements of the President's Nuclear Weapons Stockpile Memorandum, and to provide for containing initiatives to assure the vitality, develop the stability, and restore the capability of the Defense Programs' complex necessary to enable us to meet our nuclear defense requirements in the future.

DEFENSE PROGRAMS MISSION

Develop and maintain a capability to design, test and manufacture all U.S. nuclear weapons.

Develop and maintain a capability to produce all nuclear materials required for the U.S. weapons programs and manage defense nuclear wastes.

Conduct a program to develop inertial fusion in support of the nations military needs and as potential energy source.

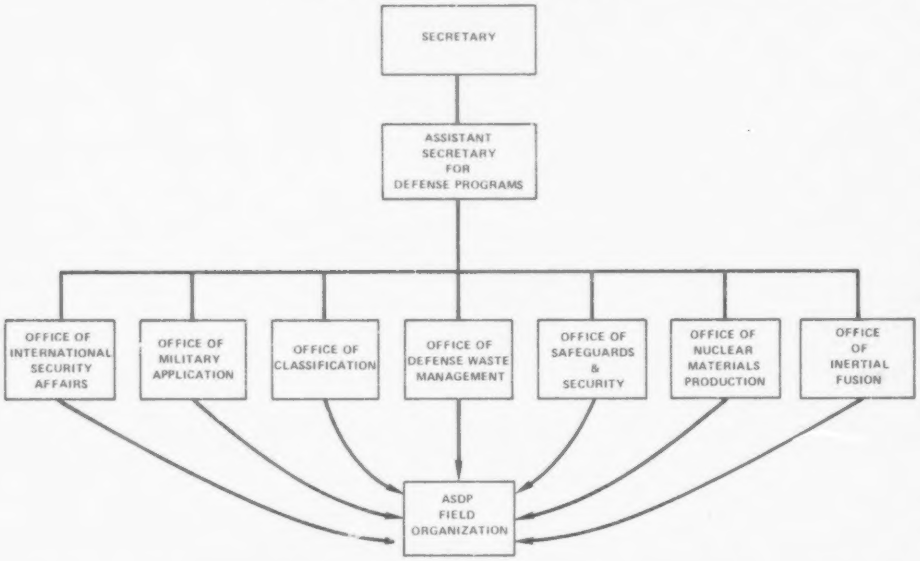
Insure the protection, control and accountability of special nuclear materials and DOE facilities.

Develop and maintain a capability to assure verification of international arms agreements and to control the transfer of sensitive technology and equipment.

Execute a program to control the dissemination of classified information.

This chart highlights the Defense Programs' mission.

ASDP HEADQUARTERS ORGANIZATION


SECRETARY
ASSISTANT SECRETARY FOR DEFENSE PROGRAMS
OFFICE OF INTERNATIONAL SECURITY AFFAIRS
OFFICE OF MILITARY APPLICATION
OFFICE OF CLASSIFICATION
OFFICE OF DEFENSE WASTE MANAGEMENT
OFFICE OF SAFEGUARDS & SECURITY
OFFICE OF NUCLEAR MATERIALS PRODUCTION
OFFICE OF INERTIAL FUSION
ASDP FIELD ORGANIZATION

In order to accomplish these mission goals, we are organized in DOE Headquarters as shown, with weapons, nuclear materials production, defense waste, inertial confinement fusion, international security affairs, safeguards and security, and classification. With that introduction, I will discuss our request for each of these programs, except for classification which does not require program funding from the Defense Activities appropriations. My Deputy Assistant Secretaries are here with me to assist in responding to any detailed questions you may have. They are Mr. James W. Culpepper, Acting Principal Deputy Assistant Secretary, and Dr. F. Charles Gilbert, Acting Deputy Assistant Secretary for Nuclear Materials.

I would like to begin with the nuclear weapons program.

Fiscal year 1982 weapons budget authorization request

	Millions
Operating:	
Research, development, and testing	$955
Production and surveillance	1,352
Program direction	41
Total operating	2,348
Construction	419
Equipment	186
Total weapons program	2,953

NUCLEAR WEAPONS PROGRAM

The fiscal year 1982 authorization request for the weapons program totals approximately $3 billion.

WEAPONS PROGRAM

Scope: Develops, tests, and manufactures all U.S. nuclear weapons; maintains reliable weapons for their operational life; disassembles and disposes of nuclear weapons upon retirement.

Authority: Atomic Energy Act of 1954, as amended (transferred to DOE by Public Law 95-91, "DOE Organization Act").

Purpose: To assure continued U.S. capability to maintain the nuclear deterrence required for national security.

First, however, by way of background, the weapons program scope, authority and purpose are shown on this chart. The program:

Develops, tests, and manufactures all U.S. nuclear weapons; maintains reliable weapons for this operational life; disassembles and disposes of nuclear weapons on retirement.

The progam authority is in the Atomic Energy Act of 1954, as amended, and is established in the DOE by Public Law 95-91, the DOE Organization Act.

The purpose of the program is to assure continued U.S. capability to maintain the nuclear deterrence required for national security.

This map [map deleted] shows the location of the DOE weapons program facilities. Very briefly, let me point out the design laboratories, the Lawrence Livermore National Laboratory, the Los Alamos National Laboratory, and the Sandia National Laboratories in Livermore, California, and Albuquerque, New Mexico. Also shown is the Nevada Test Site, northwest of Las Vegas. The seven production plants, are identified by the circular dots on the map.

This montgage [chart deleted] shows a view of each of the production plants. This one [chart deleted] shows the laboratory activities; and this one [chart deleted] depicts our testing activities.

Now, let me proceed to address our budget.

OPERATING

The proposed operating program for $2.3 billion includes funding for production and surveillance; research, development, and testing; and program direction.

PRODUCTION AND SURVEILLANCE

The budget authority and authorization requested for production and surveillance activities in fiscal year 1982 amounts to $1.4 billion, an increase of $372 million, or about 38 percent, over fiscal year 1981.

The funds requested are for production of new war reserve weapons, lifetime surveillance and maintenance of the weapons stockpile to assure its high state of readiness and reliability; process development to prepare for new designs and improve technology; retirement of warheads, which involves the recovery and reprocessing of nuclear materials; and beginning a stockpile improvement program to modernize certain older weapons currently in the United States nuclear stockpile. Our resource allocations are rising to accommodate increases in DOE delivery requirements, inflation, and the initiation of a stockpile improvement program.

This next chart [chart deleted] displays nuclear weapons deliveries projected through fiscal year 1987. These deliveries are based on the fiscal year 1981 Presidential Stockpile Memorandum, approved by President Carter in October 1980. The increases in deliveries in fiscal year 1980 and fiscal year 1981 will continue and will accelerate in fiscal year 1982. While the number of deliveries is impressive by itself, the variety of weapons being produced and their sophistication is at least as important from the standpoint of production workload.

The systems to be produced in fiscal year 1982 are B61-3/4 Bomb, W70-4 Lance Warhead, W76 Trident Warhead, W78 Minuteman III Warhead, W79 8-Inch Artillery Fired Atomic Projectile, and W80-1 Air Launched Cruise Missile. Important additional work includes production engineering and long lead procurements for full scale production of the W80-0 Sea Launched Cruise Missile Warhead, the W82 Artillery Fired Atomic Projectile, the B83 Bomb, the W84 Ground Launched Cruise Missile warhead, the W85 Pershing Missile Air/Surface Burst warhead, and the MX warhead. Also involved is the W68 Poseidon warhead retrofit program, and the ongoing program for retirement of weapons.

Still, there is another increment of work which we will begin in fiscal year 1982, and plan to accelerate in future years. I refer to the stockpile improvement effort depicted in the upper right hand part of the chart. This effort would involve a partial rebuild of certain of the warheads now in the stockpile.

Why is this necessary now? The requirement comes from a combination of factors, but in the main is related to the aging of the stockpile and the greatly improved safety and control standards of today. For roughly the first two decades of the U.S. nuclear weapons program, 1948 to 1968, rapid advances in nuclear weaponry and in the weapon delivery systems caused such a high rate of turnover that deficiencies of earlier designs were not a continuing concern because they were so quickly replaced.

THE STOCKPILES IS AGING

	1968	1981
Number of types in stockpile	26	24
Age of oldest warhead	11	23
Average age of warhead	7	12

In 1968, of the 26 types of stockpiled nuclear weapons the oldest was 11 years old and the average age was 7 years. Thirteen years later, in 1981, of the 24 types of nuclear weapons in stockpile, the oldest is 23 and the average is 12 years, almost double the earlier stockpile retention period. The stockpile is aging, and as a consequence we find outmoded technology in our weapons more frequently than is comfortable.

To further aggravate the situation, a few of the old weapons are scheduled to remain in the U.S. stockpile into the 1990's. Certain important features of these weapons should be brought up to today's more stringent standards.

STOCKPILE IMPROVEMENT PROGRAM

Implementation of this improvement program would provide: Enhanced electrical safety; reduced risk of plutonium scatter; improve command and control flexibility.

Learning from experience and capitalizing on emerging new technology has permitted inclusion of features such as these in our most modern weapons. [Deleted.]

PRODUCTION UNCERTAINTIES

Technical problems: Strong-link switch for B61 bomb (1979); Titanium mounts for W78 Minuteman III (1980).

Unanticipated requirements: increase in quantity and production rate for W80, ALCM (1981); twelve digit coded switch for W84, GLCM (1981).

Economic factors: Abrupt increases in labor, material, and utility costs (1980 and 1981).

Turning now to the management side of production, I want to ask for your help in addressing an almost perennial problem, the matter of additional funding for unanticipated production problems. This year, as is our normal practice, the estimate of funding requirements was formulated based upon a success-oriented program in accomplishing the production workload without provision for unforeseen technical, manufacturing, administrative, or economic problems. When due consideration is given to the fact that production workload and output is increasing significantly in fiscal year 1982 and beyond; that over 2,000 production plant employees must be hired, cleared, and trained during fiscal year 1982, and that four new weapons systems will be entering production in fiscal year 1982 in addition to seven weapons systems already in production, there is a high probability that unforeseen problems will occur. These problems will require rescources to resolve.

In the normal course of events, this kind of situation results sometimes in a reprogramming action, sometimes in a supplemental appropriation request, but always in a certain amount of delay and dislocation within the program. In an effort to avoid that delay and disloaction and consequently to ensure the timely production and delivery of all required weapons, a "risk factor" equal to approximately two percent of the production and surveillance operating budget has been included in the fiscal year 1982 budget request.

I believe this approach can provide the necessary management flexibility to respond to many unexpected adverse developments while still retaining the required Congressional oversight and control of funding.

This concludes my remarks on the operating budget for production. I will now address the request for research, development, and testing.

RESEARCH, DEVELOPMENT, AND TESTING

The total authorization request for research, development, and testing is $955.1 million, $369 million for testing and $586.1 million for research and development. This funding level reflects a decision to return to a more vigorous testing program and support the associated research and development.

RESEARCH AND DEVELOPMENT

The $586.1 million requested for research and development is an increase of about 16 percent over fiscal year 1981. These funds provide the resources—manpower, materials, and services—needed to support the weapons program.

Our research and development efforts are conducted principally by three organizations: the Lawrence Livermore National Laboratory (LLNL), the Los Alamos National Laboratory (LANL), and the Sandia National Laboratories (SNL).

This chart [chart deleted] shows the trend for our research, development, and testing activities since fiscal year 1970. During the past decade funding (in constant dollars) for the weapons research, development and testing program has declined by 37 percent and employment by 25 percent. As you will note, in recent years our R&D manpower has stayed at about 7,400. While this can be viewed as a constant level of effort, it must be noted that emphasis on current weapon R&D has resulted in a reduction in the effort on the development of advanced concepts. The addition of 450 R&D employees in fiscal year 1982 will provide a start on rebuilding our capacity to deal with the long-range research and development issues, as well as keeping up with the current need for weapon design.

The primary thrust of program growth will be in the technology base area of research which has been too long neglected. The major emphasis will be on building a sound program to advance nuclear weapon technology at the fundamental level. Thirty-five years into the nuclear age we must still admit that our understanding of certain nuclear processes is still imperfect.

FISCAL YEAR 1982 WEAPONS TESTING BUDGET

[BA dollars in millions, fiscal years]

	1981	1982
Testing	$261	$369
Supplemental request[1]	35	
Total	296	369

[1] Supplemental also includes $6,000,000 R. & D. operating and $10,000,000 capital equipment for testing

TESTING

To support this expanded testing effort, we are requesting authorization of $369 million in fiscal year 1982. This amount represents a total increase of about 25 percent over fiscal year 1981.

This chart [chart deleted] displays the recent history of the testing program. The lines show the number of tests in each year. You will note, the dramatic increase in testing [deleted]. The proposed program of [deleted] tests includes [deleted] for weapons development, engineering, and certification, and [deleted] for the technology base. This program will support all ongoing warhead developments as currently defined in the Presidential Stockpile Memorandum and provides an opportunity to address more vigorously some of the fundamental problems in nuclear technology. It will also put the U.S. testing program on a more equal footing with [deleted] Soviet testing.

PROGRAM DIRECTION

Our final operating category is program direction.

This budget category includes $41.4 million for the salary, benefits, and travel expense of 981 Federal employees associated with the technical direction and management of the weapons program. Included is the funding required for the contractual services and supplies necessary to support the DOE Albuquerque and Nevada Operations Offices.

Now, I will discuss our plant and capital equipment funding proposal.

PLANT AND CAPITAL EQUIPMENT

The United States for the foreseeable future must maintain a balanced nuclear weapon research, development, and testing effort and a production base (including the production of nuclear materials) capable of delivering about [deleted] with some surge capability. A decade of underfunding however, has resulted in poor and inadequate facilities and outmoded equipment throughout the complex. With the support of this Committee the DOE, in fiscal year 1980, instituted a planned six-year funding program to restore the nuclear weapon complex.

The line on this chart [chart deleted] shows the funding required to support that program. The funding represented here is really a composite of several items in the budget and I would like to take a moment to identify them and make a comment.

To revitalize the complex, two separate but related actions are required. First, we must restore those facilities and equipment which have already become poor or inadequate and secondly, we must maintain those facilities and equipment which are currently adequate. The first action, restoration, is supported by the restoration project which is a line item in our construction budget. The second action, maintenance, is supported by the capital equipment budget and the GPP line in the construction budget. A shortage of funding in any of these items delays the day when the weapon complex can be returned to an adequate operating condition, increasing the probability of equipment and utility failures that could result in production stoppage, and further increasing the risk that the United States will lose the competition for the lead in nuclear technology.

A delay in funding for this new capital equipment and construction has the effect of increasing the outyear requirements for operating funds (e.g., increased maintenance), to the extent that this limited substitution is possible. Adequate funding for restoration makes possible a cost effective balanced program, and will minimize total production costs in the long run.

Having said that our restoration and maintenance program will return the complex to adequate condition I feel I would be remiss if I did not expand a bit on what is meant by the term "adequate" with respect to the production complex.

At the successful conclusion of our six-year program there will be seven production plants with well maintained, relatively modern equipment and utilities. These plants will be capable of producing about [deleted] moderately complex new weapons per year, retiring a similar number of old weapons, and processing a moderate number of retrofits.

This chart [chart deleted] points out two [deleted] shortcomings in an otherwise adequate complex. First, the lack of any significant surge capability [deleted]. Second, the lack of redundancy in the complex makes weapon production vulnerable to a variety of threats, such as, man-made or natural disasters. The nuclear weapon production of the United States is basically a "one track" system. [Deleted]. Because of the concerns raised by these issues, the DOE plans to initiate a study in fiscal year 1982 to identify and evaluate economically feasible actions which could be taken to provide a modest surge capability and to provide a measure of redundancy [deleted] in the event of a natural or man-made disaster at a facility. This study will be coordinated with the requirements for nuclear materials to support surge capacity.

Moving now to the construction line items, the total requested for the fiscal year 1982 authorization is $419.4 million. Our request includes eight new projects other than those associated with GPP and restoration, seven are for production and surveillance and one is for testing. In the interest of time, I will not comment on each of these individually although I would be pleased to respond to any questions you may have about them. In general, the production and surveillance items provide necessary capacity or capability to support specific production requirements.

Next, I will take up the inertial confinement fusion program.

INERTIAL CONFINEMENT FUSION

INTRODUCTION

The near-term goal of this program is to determine the full potential of inertial fusion for applications to nuclear weapon [deleted] technology and to nuclear weapon effects simulation. The achievement of this potential will be a significant addition to the capabilities of the nuclear weapons design national laboratories.

In the longer term inertial fusion could emerge as a candidate energy technology.

The next major step in the program is to demonstrate the conditions for thermonuclear ignition. The core R. & D. program of experiments using existing short and long wavelength lasers and light ion accelertaors is directed toward this ignition objective.

These experiments will permit us to project with confidence the precise conditions required to reach the level of high gain. High gain is defined by the conditions at which the fusion energy produced exceeds by 50–100 times the beam energy used to ignite the fuel. In addition to the core program, we have been investigating alternative drivers that promise significant advantages as high gain drivers. High energy gain will meet most if not all of the requirements for the nuclear weapon technology applications. At the same time this will establish the scientific basis for an engineering program to develop inertial fusion energy systems.

The intertial fusion program is being rescoped to concentrate on obtaining an R&D "deliverable" using current facilities and facilities under construction. This will better define the ultimate potential of the various driver technologies. Accordingly, no funding is being requested in 1982 for advanced technology development which anticipated the construction of larger next generation laser facilities.

BUDGET REQUEST

DOE is requesting $106 million in operating funds for the inertial fusion program under Atomic Energy Defense Activities. For capital equipment not related to construction we are requesting $11 million. No new authorization is being requested for construction.

PROGRAM STATUS

Thus far we have succeeded in developing complex computer codes to calculate the physical processes we are encountering. We have built and scaled up in energy both laser and particle beam drivers. We have developed techniques to fabricate complex fuel pellets to extremely high tolerances at very small scale. New techniques have been devised to diagnose the results. The close agreement between our theoretical understanding of fusion and the results of experiments sustain our confidence in achieving ignition with the current experimental program.

The inertial fusion programs in the nuclear weapon laboratories have begun to contribute data and new physics understanding to the weapons [deleted] programs. In addition, the conditions required for ignition are coming into focus, and good agreement is being obtained between current experimental results and theoretical predictions. The term ignition indicates achievement of significant burn, though not necessarily the release of net amounts of fusion energy.

LEAD LABORATORIES FOR INERTIAL FUSION

Short wavelength laser experiments—LLL—LLL, KMS fusion, Univ. of Rochester, NRL; long wavelength laser experiments—LASL; pulse power (light ions)—SLA; heavy ions—LASL—LASL, BNL, ANL, LBL, LLL; advanced lasers—LLL—LLL, LASL, SLA, contractors.

DOE has instituted lead laboratory arrangements for the major technical activities in the inertial fusion program. The three nuclear weapons laboratories—Sandia-Albuquerque, Los Alamos, and Lawrence Livermore—are the lead laboratories charged with developing and implementing program plans for the pulsed power, long wavelength laser, and short wavelength laser activities respectively. In addition Los Alamos is the lead laboratory designated for heavy ion development, and Livermore for advanced laser development. I would like to touch briefly on the activities in each of these areas.

OPERATING PROGRAM

In fiscal year 1982 we are requesting $58 million for glass laser experiments. The glass laser systems now operating in the program are the Argus and Shiva lasers at Livermore, the Omega system at the University of Rochester, the Chroma system at KMS Fusion, Inc., and the Pharos laser at the Naval Research Laboratory. Conversion of the Argus and Chroma systems to operate at very short wavelengths has been very successful, exceeding our expectations. Target experiments conducted over the past year at very short wavelengths have verified significant improvement in the coupling of light energy to targets. Last summer a prototype target for Nova was successfully imploded to about 100 times the density of solid hydrogen. This is an important milestone on the way to compression to 1000 times solid density, which is required for target ignition.

The Nova facility buildings are nearing completion and intial procurement of laser hardware is under way. We are now reviewing the total cost estimate for this facility.

These mainline activities are supported by theory and experiments conducted at three laboratories. The Naval Research Laboratory effort is concentrated in plasma physics modeling and experiments. KMS Fusion, in addition to its target fabrication work, has been using its upgraded laser both for short wavelength absorption measurements and for simulation of large scale plasmas. These results are important for modeling aspects of the physics that will be encountered at the scale of Nova targets. The University of Rochester Laboratory for Laser Energetics, which has its own university and industry supported feasibility project, and also serves as a users facility for laser experiments, has supported the mainline program by demonstrating efficient conversion to very short wavelengths.

GAS LASER EXPERIMENTS

We are requesting $33.3 million for the experimental program at Los Alamos. The long wavelength laser experiments are being carried out on the Helios carbon dioxide laser system. Improvements in laser technology have permitted operation of Helios at increasing levels of energy on target during the past year. New diagnostics have been developed to assist in measuring these interaction phenomena. Progress is being made in developing a theoretical understanding of these processes and determining the efficiency of long wavelength light for driving targets to the highly compressed state required for thermonuclear ignition.

The near-term objective of this program activity is to bring into operation the 35–40 kilojoule Antares laser system as the primary long wavelength target irradiation facility in the program. The laser is scheduled to be completed in fiscal year 1983. Experiments will begin in fiscal year 1983 to determine the laser energy and target design requirements to reach target ignition with long wavelength lasers. An important activity over the next three years will be to develop targets for Antares. A target fabrication facility is now under construction near the Antares building. We are requesting $7.3 million in fiscal year 1982 for this facility, which was fully authorized in fiscal year 1981. We believe that, with the provision of these facilities, we will be able to meet the experimental goals of this part of the program.

PULSED POWER EXPERIMENTS

Pulsed power denotes the use of large energy storage and switching systems to form streams of electrons or light ions, particles which can be focused on fusion pellets much as beams of laser light are. For this activity we are requesting $13.4 million. This activity is supported by work at the Naval Research Laboratory, Cornell University, and a number of industrial contractors.

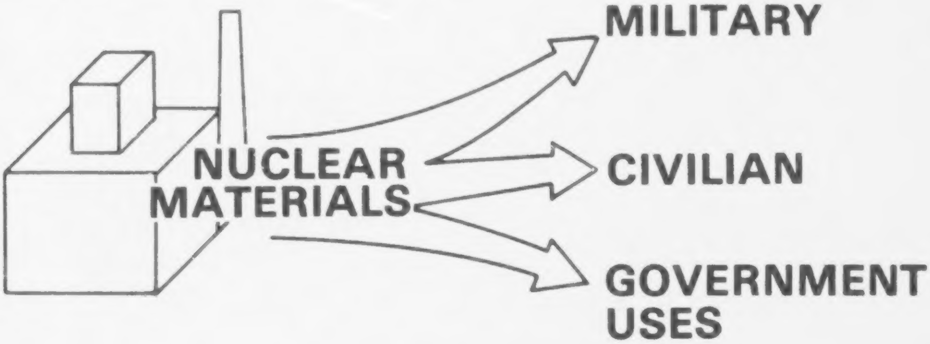
The Particle Beam Fusion Accelerator (PGFA–I) at Sandia-Albuquerque was completed last year and is now in operation. Pulsed power technology has progressed to the point that will shortly begin significant target experiments in this area. The objective of these experiments will be to demonstrate significant thermonuclear burn using beams of light ions. Similtaneously Sandia will be proceeding with procurements for the upgrade of this facility authorized last year and scheduled to be completed in fiscal year 1984. Our present projections are that the upgraded facility will demonstrate target ignition. In time, improvements in the target design and experience with the facility should permit us to reach breakeven and perhaps even net energy gain.

The Inertial Confinement Fusion program is in the midst of important facility construction that will make it possible, in the fiscal year 1985–88 timeframe, to accomplish the next major scientific milestone of ignition demonstration. We believe the program is progressing well toward that major objective and request continued support to meet our experimental program and facility commitments.

I will now turn to the Department's nuclear materials production program request.

NUCLEAR MATERIALS PRODUCTIONS PROGRAM

The nuclear materials production budget request for fiscal year 1982 is $1,108.4 million in new authorization and $930.7 million in budget authority. This budget provides for continuation of our base materials production operations from fiscal year 1981, continuation of the initiatives which were begun in fiscal year 1981 and new initiatives which we are proposing for fiscal year 1982. I will discuss the details of these initiatives later in my presentation.

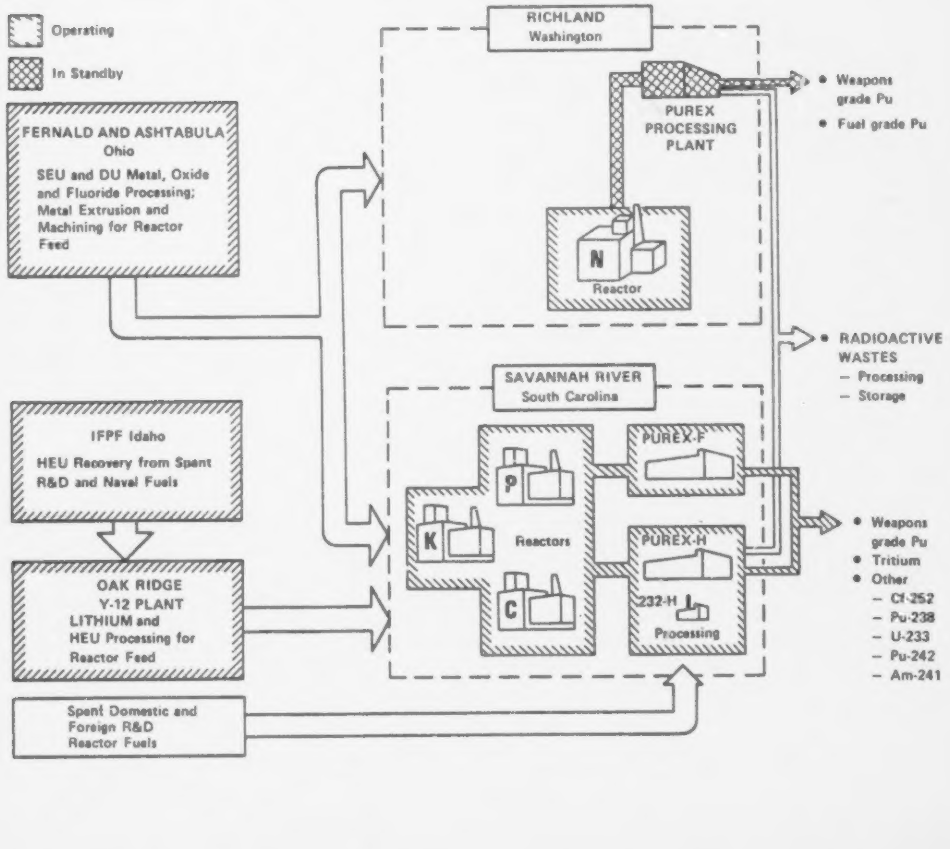

NUCLEAR
MATERIALS
MILITARY
CIVILIAN
GOVERNMENT
USES

PROGRAM OBJECTIVES

The Office of Nuclear Materials Production has as an objective the production of nuclear materials for military programs, government research and development programs such as the breeder reactor, and civilian programs which use radioisotopes in commercial applications.

To accomplish this objective, as you know, we have major nuclear materials production facilities at the sites shown on this chart.

DOE NUCLEAR MATERIALS PRODUCTION
AND WASTE MANAGEMENT OPERATIONS


Operating
In Standby
FERNALD AND ASHTABULA
Ohio
SEU and DU Metal, Oxide and Fluoride Processing; Metal Extrusion and Machining for Reactor Feed
IFPF Idaho
HEU Recovery from Spent R&D and Naval Fuels
OAK RIDGE
Y-12 PLANT
LITHIUM and HEU Processing for Reactor Feed
Spent Domestic and Foreign R&D Reactor Fuels
RICHLAND
Washington
PUREX PROCESSING PLANT
N
Reactor
• Weapons grade Pu
• Fuel grade Pu
• RADIOACTIVE WASTES
– Processing
– Storage
SAVANNAH RIVER
South Carolina
P
K
Reactors
C
PUREX-F
PUREX-H
232-H
Processing
• Weapons grade Pu
• Tritium
• Other
– Cf-252
– Pu-238
– U-233
– Pu-242
– Am-241

Highly-enriched uranium is recovered from spent Naval and test reactor fuels at Idaho, and shipped [deleted] to the Oak Ridge Y-12 Plant, which converts [deleted] to metallic uranium. This enriched uranium is then alloyed with aluminum and fabricated into fuel tubes for subsequent charging along with depleted uranium targets for plutonium production or along with enriched lithium targets for tritium production. The irradiated enriched uranium is processed at the chemical processing plant at Savannah River for recycle of the remaining enriched uranium.

The depleted uranium is processed at Fernald into metallic uranium, and is cast into cylinders. These castings are shipped to Ashtabula for extrusion and machining to the proper dimensions. The uranium cores are shipped to Savannah River, clad with aluminum and prepared for loading into the Savannah River reactors. Irradiated targets are processed in the chemical processing plant at Savannah River to recover the plutonium for weapon use.

The N Reactor at Richland uses slightly-enriched uranium fuel, to power the reactor and to produce plutonium. The slightly-enriched uranium is converted to metal at the Fernald, Ohio plant, and shipped to the Ashtabula, Ohio plant. The Ashtabula plant extrudes this material into cylindrical billets which are shipped to the fuel fabrication facilities at Richland, Washington. The billets are then clad with zirconium to provide finished fuel elements for the N Reactor. After irradiation in the reactor the fuel is removed and stored temporarily in basins onsite until such time as the Richland Purex plant is restarted. The Purex plant can process this fuel to recover the plutonium and also to recover the remaining uranium for reuse.

Chemical processing wastes from prior Purex operation at Richland and from the Savannah River chemical processing plants are now stored onsite.

NUCLEAR MATERIALS REQUIREMENTS

This chart [chart deleted] summarizes the plutonium and tritium requirements for the weapons systems. The DOE tritium and plutonium production program is based primarily upon the projection of the U.S. nuclear weapons requirements as reflected in the fiscal year 1981 Nuclear Weapons Stockpile Memorandum approved by the President in October 1980. This memorandum contains stockpile projections for planning purposes through fiscal year 1988. The production plans in this period include the MX warhead, the Minuteman III warhead, the Trident warhead, the Cruise missiles and several new theater nuclear systems. Most of the nuclear materials required for building new warheads are obtained by reclaiming and recycling existing materials from retired weapons returned by the DOD. Weapon program requirements which cannot be met from DOD returns or existing DOE inventories are satisfied by production of new nuclear materials. The stockpile now contains about [deleted] of plutonium and tritium and the total requirement will increase to over [deleted] by the late 1980's.

The first priority in nuclear material production must be tritium. Tritium is a vital material in [deleted] our nuclear weapons and, due to its natural radioactivity, is constantly decaying at a rate of 5.5 percent per year.

[Deleted.]

This chart [chart deleted] illustrates how we plan to meet tritium and plutonium requirements as identified in the Stockpile Memorandum. The ordinate in this chart is [deleted] plutonium equivalent where tritium is included with plutonium in terms of its equivalent reactor productivity. The quantities of nuclear materials required for the weapon program are directly related to the quantities and types of nuclear weapons authorized by the President.

The initiatives to increase production capacity, approved by Congress and initiated in 1981, are essential if DOE is to meet nuclear material requirements beyond fiscal year 1985. Without this, shortfalls would occur throughout fiscal year 1988 and beyond. These steps to increase production include: conversion of N Reactor at Richland, Washington, from production of fuel-grade plutonium to weapon-grade plutonium; upgrading of the Purex fuels reprocessing plant at Richland, Washington, to allow subsequent restart to recover plutonium from irradiated N Reactor fuel; upgrading of a retired reactor, L Reactor, for subsequent restart at Savannah River, South Carolina; restoration of existing production reactors and other production facilities to offset the continual loses in productivity over the past decade; and production of high purity plutonium at Savannah River for blending with existing fuel-grade plutonium to yield additional weapon-grade plutonium.

This chart [chart deleted] summarizes the fuel-grade plutonium supply and demand assuming restart of the Richland PUREX fuel reprocessing plant. Fuel-grade plutonium is required for blending with higher purity plutonium to produce more weapon-grade material; for the breeder program including the Clinch River Breeder Reactor (CRBR); and for basic research and development programs, primarily the Fast Flux Test Facility. The CRBR requirements shown in the chart are based an startup of the reactor in 1990. A potential fuel-grade plutonium shortage is projected to occur after 1991 based on the currently projected supply and demand situation. This shortfall would occur earlier if new weapon requirements are provided by the DOD, if current production facilities have operational problems, or if new production initiatives are not implemented on schedule. The defense program needs for fuel-grade plutonium will receive the higher priority, if demand for fuel-grade plutonium should exceed supply.

PRODUCTION INITIATIVES

In fiscal year 1981, Congress authorized and appropriated funds to initiate new plutonium production activities. These initiatives are continued into fiscal year 1982 as shown on this chart, as well as new initiatives we are proposing for fiscal year 1982. I will now discuss each of these initiatives in detail.

RESTORATION AND MAINTENANCE

Over the past decade, the availability of maintenance and equipment funding has not been adequate to support the Nuclear Materials Production complex, much of which has been operating continuously for 25 to 30 years.

The current backlog of restoration requirements has accumulated to approximately $400 million (in fiscal year 1982 dollars) plus an additional, yet to be determined, amount for work at the Idaho Fuels Processing Facility. In June 1979, DOE submitted an assessment report to the Congress which identified facility deficiencies and established a five year funding plan to restore DOE production facilities. Correction of these deficiencies will improve operations, safety, reliability, and efficiency. Funding of $26 million, which was sufficient to initiate a seven-year program was provided in fiscal year 1981. For fiscal year 1982, a total of $150.6 million new authorization and $81 million in budget authority is requested which will enhance completion of the Facility Restoration Program to six years. The plants being restored under this program are the only available sources of supply of the additional nuclear materials for weapons fabrication and energy research and development programs.

The fiscal year 1982 request also includes $28 million of authorization and budget authority to increase the maintenance funding to a level which will halt further deterioration.

L REACTOR UPGRADE

The fiscal year 1982 request includes $84.7 million new authorization and $58.7 million in budget authority for the L Reactor upgrade program. It will take three years and $184 million to restore this reactor to a ready status. The Savannah River reactors are the Nation's primary source of new plutonium and tritium for defense programs.

Since the L Reactor was shut down in 1968, many capital projects have been undertaken to improve the safety and efficiency of the remaining three operating reactors at Savannah River. These changes now need to be incorporated into L Reactor to bring it to a condition equivalent to that of the operating reactors.

INCREASED PLUTONIUM PRODUCTION

The fiscal year 1982 request includes $20.8 million in authorization and budget authority to obtain additional weapon-grade plutonium by beginning production of high-purity plutonium (3 percent Pu-240) at Savannah River for blending with existing fuel-grade plutonium (12 percent Pu-240) from Richland. The program was initiated in fiscal year 1981 and provides for the production of depleted uranium feed and fabrication of additional targets for the production of high purity plutonium and for storage basin modifications to handle the increased volume of irradiated plutonium targets. The benefits of blending are the realization of additional weapon-grade plutonium (6 percent Pu-240) for the weapons program.

IMPROVED REACTOR SAFETY

Funding of $5 million in fiscal year 1981 was provided to increase the operating safety of the three Savannah River reactors and the N Reactor at Richland by initiating safety improvements associated with the lessons learned from the Three Mile Island incident. The fiscal year 1982 request includes $47.9 million authorization and $15 million budget authority to continue these activities. The need for these improvements was identified during assessments by DOE of the operations of the four major production reactors in light of the Kemeny Commission report.

SPECIAL ISOTOPE SEPARATION

The fiscal year 1982 budget request of $25.8 million in authorization and budget authority is for continuation of the Special Isotope (plutonium) Separation program. An isotope separation plant could "clean up" the existing weapon-grade plutonium stockpile by removing Pu-240 and Pu-241 which are byproducts of weapon-grade plutonium production. This plant also could increase the supply of weapon-grade plutonium by enriching the Pu-239 in available fuel grade, [deleted] plutonium [deleted].

Removing Pu-240 and Pu-241 from weapon-grade plutonium would reduce the sources of neutron and gamma radiation in nuclear weapons. This would reduce the radiation exposure to DOE Defense Programs personnel during plutonium recovery operations and weapon fabrication and disassembly and to DOD personnel during weapon deployment in ships and submarines. A reduction of the impurity content of weapon-grade plutonium by use of isotope separation would offset the financial and other impacts resulting from future potential reductions in personnel exposure limits.

In addition, a Special Isotope Separation production plant could cost-effectively separate less fissile plutonium isotopes for nuclear weapons research [deleted] for example, Pu-240 and Pu-242, from fuel-grade [deleted] plutonium.

A Special Isotope Separation production plant would provide the DOE Defense Programs' effort with capabilities unavailable at present. The fiscal year 1982 request will allow DOE to complete construction of a Special Isotope Separation production plant about fiscal year 1988.

PUREX/N REACTOR

The fiscal year 1982 budget request includes a total of $48.6 million authorization and $46.9 million budget authority for second year operating funds to continue upgrading the Purex fuel processing plant and its supporting facilities at Richland. Purex reactivation could be implemented by about mid-fiscal year 1984. The upgrading includes cell-by-cell repair and checkout and operability testing of all process systems. Maintenance and operability testing to date and three separate facility and safety assessments indicate that Purex can safely and reliably begin operations. An additional $27.7 million authorization and budget authority is included to continue the conversion of N Reactor from fuel-grade to weapon-grade plutonium production. During fiscal year 1982 procurement of zirconium will be accelerated to support doubling finished fuel fabrication and additional personnel will be hired and trained for this activity.

REPLACEMENT PRODUCTION REACTOR

The fiscal year 1982 budget request includes $5 million authorization and budget authority for conceptual design to continue the program initiated in fiscal year 1981. The $5 million funding in fiscal year 1982 will provide for the beginning of conceptual design of the reactor concept we are planning to select in fiscal year 1982.

FLUORINEL AND ROVER FACILITIES STARTUPS

Funding of $8.3 million authorization and budget authority is included in the fiscal year 1982 budget request to initiate the activities needed to operate the new Fluorinel and Rover facilities at the Idaho Fuels Processing Facility (IFPF).

The new Fluorinel facility will store and dissolve naval and DOE nuclear fuels preparatory to their separation for uranium recovery. The Rover facility will recover useful highly enriched uranium from fuels used in the old Rover nuclear propulsion program. Rover activities include preoperational and startup testing of equipment leading to full-scale processing operations in late fiscal year 1982.

IDAHO UPGRADE AND REPLACEMENT

The fiscal year 1982 budget request includes $43 million authorization and $17 million budget authority to initiate activities needed for immediate upgrade and later replacement of selected process systems at the IFPF. The IFPF is a key Defense Programs facility for recovery of enriched uranium from spent cores of Naval Reactors and other DOE reactors. Upgrading of deteriorated fuel processing facilities and systems by late fiscal year 1985 will allow us to meet projected fuel processing requirements. In addition to the upgrade effort, the funding in fiscal year 1982 will initiate preparation of conceptual design and safety analysis reports for the later replacement of selected process systems at the IFPF.

SECURITY PROJECTS

Funding of $43 million authorization and $4 million budget authority is included in the fiscal year 1982 budget request to initiate three projects at Savannah River, Richland, and Idaho for the strengthening of security of the Materials Production complex. In recent years, as a result of the changing social climate, increased security is necessary to protect the production facilities against terrorist threat. Recent DOE assessments have identified vulnerabilities which should be corrected in the immediate future.

I will now summarize our budget request for operating, capital equipment, and construction funds.

OPERATING EXPENSES

As shown in the previous chart, the fiscal year 1982 total budget request is $1,108.4 million in new authorization and $930.7 million in budget authority. The 1982 request for Nuclear Materials Production operating expenses is $616.2 million in authorization and budget authority, which is $157.6 million above the 1981 allowance.

CAPITAL EQUIPMENT

The fiscal year 1982 request for Nuclear Materials Production Program capital equipment is $73.6 million in authorization and budget authority, which is an increase of $26.5 million above 1981. The increased capital equipment request is required to support production initiatives and also reflects the increased need to maintain and repair equipment which is reaching the end of its service life. Significant annual repair and replacement is required to keep our aging nationwide complex of production facilities operating reliably, which has a total escalated acquisition value of approximately $11 billion in fiscal year 1982 dollars.

The DOE also proposed to lease in fiscal year 1981 an additional IBM or IBM compatible computer system at Savannah River to augment currently installed IMB 360/158 systems. The action is an acceleration of a planned and budgeted fiscal year 1982 acquisition. Whereas the basic requirements for this computer system have not changed, additional requirements have developed since submission to the fiscal year 1981 budget which necessitate this acceleration action. The increased computer requirements result from expanded Nuclear Materials Production activities.

CONSTRUCTION PROJECTS

The 1982 request for nuclear materials production program construction projects is $418.6 million in new authorization, an increase of $235.2 million above the authorization provided in fiscal year 1981, and $240.9 million in budget authority, which is $80.9 million above that appropriated in 1981. This amount includes $123 million for six projects authorized in previous years and $117.9 million for ten new projects. These projects are summarized in the following charts.

FISCAL YEAR 1982 MATERIALS PRODUCTION BUDGET CONTINUING CONSTRUCTION PROJECTS

[In millions of dollars]

	Total estimated cost	Through fiscal year 1981		Fiscal year 1982	
		Authorization	Appropriation	New authorization	New appropriation
81-D-128—Restoration of production capabilities, phase I	51.9	35.0	24.3	14.4	15.0
81-D-131—Remote analytical facility upgrade and expansion, ID	28.5	28.5	5.0		13.0
81-D-143—L reactor upgrade, SR	115.0	49.0	35.0	66.0	40.0
80-AE-2—Replace obsolete processing facilities, HB-line, SR	20.0	19.0	8.2		5.0
80-AE-3—Steam generation facilities, ID	29.0	23.5	18.5	5.0	10.0
77-13-A—Fluorinel dissolution process and fuel receiving improvement, ID	200.0	149.4	149.4	50.0	40.0
Subtotal				135.4	123.0

NEW CONSTRUCTION PROJECTS

[In millions of dollars]

	Total estimated cost	New authorization	New appropriation
82-D-116—General plant projects	23.0	23.0	23.0
82-D-117—Plant engineering and design	3.0	3.0	3.0
82-D-118—N plant security and surveillance, RL	4.0	4.0	1.0
82-D-124—Restoration of production capabilities, phase II	127.0	126.0	55.8
82-D-126—Reactor safety and reliability	42.9	42.9	10.0
82-D-127—Safeguards improvements, SR	36.0	34.6	2.0
82-D-128—Plant perimeter security systems upgrade, ID	4.4	4.4	1.0
82-D-136—ID fuels processing facility, upgrade and replacement, phase I	40.0	40.0	14.0
81-D-126—Pollution abatement facilities, RL	5.6	4.3	2.6
81-D-142—Steam transfer header, SR	8.0	1.0	5.5
Subtotal		283.2	117.9
Grand total		418.6	240.9

Now I will move on to the defense nuclear waste program request.

DEFENSE NUCLEAR WASTE

The authorization request for this program for fiscal year 1982 is $369.7 million compared to $361.9 million in fiscal year 1981. Of this total, $262 million is for operating expenses, $24.5 million is for capital equipment, and $83.2 million is for construction. The program reflects our commitment to the safe handling and disposal of DOE-generated radioactive wastes. Specifically, the Department will continue to dispose of low-level wastes and to place and maintain transuranic (TRU) and high-level waste (HLW) in interim storage pending availability of long-term waste disposal.

INTERIM WASTE OPERATIONS

The requested funding will provide for the safe handling and interim storage or disposal of radioactive wastes resulting from the production of nuclear materials for defense purposes and from other DOE nuclear activities.

Efforts continue to upgrade waste operations through the transfer of liquid high-level waste from old single-shell tanks to new double-shell tanks at Savannah River and Hanford, construction of improved facilities, and improvement of the burial ground operations. Increased funding in fiscal year 1982 is also requested for preoperational testing, startup, and operation of the New Waste Calcining Facility at Idaho which will be operational in late fiscal year 1982.

The upgrading of general site support equipment and facilities at Hanford will continue in order to restore operational reliability and efficiency as discussed in the congressionally requested Nuclear Materials Production and Defense Waste Management Facilities Upgrading Study report. The increase will be used to replace obsolete equipment, improve worker safety, and provide facility repairs that can no longer be deferred. A project to improve the safety of the Hanford railroad system is urgently needed.

Funding is also requested to support startup of the Purex fuel processing plant at Hanford in early fiscal year 1984.

LONG-TERM WASTE MANAGEMENT TECHNOLOGY

The goal of this program is to define and evaluate alternatives for the long-term management, and disposal of DOE's radioactive wastes. Alternative technologies continue to be developed for high-level waste, low-level waste, transuranic waste, and low-level gaseous waste. The associated hazards, costs, and environmental impacts will be assessed in order to select and implement appropriate long-term disposal alternatives.

In fiscal year 1982, the HLW technology program will continue documenting the requirements for adapting waste processing technologies to individual site requirements. Each site may require a different processing method, and possibly a different waste form, before disposal in a geologic repository. The Department will develop and evaluate at least one final waste form in addition to glass.

Funding is also requested to continue tthe engineering design of the proposed Defense Waste Processing Facility (DWPF) at the Savannah River Plant. This facility will immobilize the high level wastes and prepare them for disposal.

The Department will continue to analyze alternatives for the long-term management of buried and retrievably stored TRU wastes at all of its sites, demonstrate incineration concepts, and develop final waste forms for disposal.

The Department will continue to plan for a Transuranic Waste Treatment Facility (TWTF) at Idaho with technology development, alternative design studies, and the continuation of a nonradioactive slagging pyrolysis incinerator demonstration at Lake Buena Vista, Florida.

In fiscal year 1982, the Department will issue a waste generation reduction manual for low-level waste and continue work on a handbook on waste treatment and solidification for shallow land burial for issuance in early fiscal year 1983. Field tests of improved shallow land burial technology will be completed on an arid and a humid site and a final report issued. Field testing of intermediate-depth burial as an alternative disposal technique, begun in fiscal year 1981, will be completed in fiscal year 1984.

TERMINAL STORAGE

The WIPP mission, as authorized in Public Law 96–164, is to provide a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States. The facility will not be licensed.

A Final Environmental Impact Statement (FEIS) on the WIPP was issued on October 1980 and a 45-day comment period was allowed on that document. This step was taken by the Department to insure that the views of all interested parties would be considered prior to preparation of a Record of Decision on the FEIS. The public comment period resulted in no new or significant environmental information, and the Record of Decision to proceed was signed on January 22, 1981.

This authorization amount together with amounts provided in prior years will allow the project to be continued consistent with congressional direction. Construction of the initial exploratory shaft will begin this summer.

DECONTAMINATION AND DECOMMISSIONING

The decontamination and decommissioning of surplus defense related DOE facilities is an activity in the Nuclear Waste Management Program. The objective of this activity is to assure that the defense-related surplus facilities remain in a safe condition as we devise a plan and execute a program to decommission them. In fiscal year 1982, an effort will be made to include all surplus facilities which originated with Defense Programs, such as production reactors, fuel reprocessing plants, and waste management facilities, under this activity. The program now includes about 350 facilities, most of which are located in the Hanford Site in Richland, Washington. Richland Operations Office serves as the lead field office in this activity and provides coordination and direction to the other sites.

The funding request for fiscal year 1982 is $10.3 million, which represents an increase of $6.2 million over fiscal year 1981. The additional funds are required to manage the full complement of defense facilities, some of which were formerly carried with the Commercial Nuclear Waste Program. At the requested funding level, surveillance and maintenance will be continued for facilities at the Hanford Site, INEL, ORNL, and Mound Facility, as well as for the New Brunswick Laboratory Site, Niagara Falls Storage Site, and Weldon Spring Site. The ongoing disposition projects (six) from fiscal year 1981 will be secured in a standby program with only necessary maintenance and surveillance performed.

TRANSPORTATION RESEARCH AND DEVELOPMENT

A total of $6.9 million has been requested to support transportation research and development activities.

DOE's nuclear materials transportation program is planning and implementing activities to meet national nuclear transport needs. The activities include: Technology Development and Test, Operational Safety and Accident Analysis, and operation of a Transportation Technology Center. Specifically, we are conducting investigations of transport system interfaces to optimize system and facility designs; environmental impact analyses; analyses of institutional constraints on nuclear materials transport; and tests and evaluations of current and future generation package and transport systems. The program management responsibility has been assigned to the Albuquerque Operations Office.

Now I will turn to the verification and control technology program.

VERIFICATION AND CONTROL TECHNOLOGY

This program has five specific goals:

1. To provide the technical systems necessary to monitor foreign nuclear tests carried out in underground, atmospheric, or space environments and to monitor nuclear weapons-related treaties;

2. To provide the Department's unique weapons' and nuclear-related expertise to the Intelligence Community;

3. To conduct nuclear weapons-related analyses and nuclear weapons systems studies necessary to meet intelligence requirements;

4. To provide the necessary information to support the Department's responsibilities in controlling proposed exports of nuclear and energy-related materials, equipment, and technology in order to determine their consistency with U.S. national security and with nonproliferation policy; and

5. To assist in resolving nuclear policy issues and support DOE's participation in U.S. arms control initiatives and treaty negotiations.

The Verification and Control Technology authorization request for fiscal year 1981 was $39.5 million and the request for fiscal year 1982 is $50 million. The requested increase of $10.5 million is to: enlarge the scope of spaceborne and conventional detection technology initiatives; [deleted] and meet the continuing responsibilities of the Department in the export control and arms control areas.

The principal activities of the verification and control technology program are concerned with research, development, test, and evaluation of technical systems used to detect, identify, locate, [deleted] nuclear explosions in underground, atmospheric, and space environments. These activities directly support the verification requirements of nuclear test ban treaties and their negotiations, [deleted].

The Program consists of three functional cross-program components. These are: (*a*) a base technology component; (*b*) an applications component; and (*c*) an operational component.

BASE TECHNOLOGY

The base technology program, for which $11.2 million is requested (an increase of $3.7 million over fiscal year 1981), provides for research in nuclear explosion detection and related disciplines. It seeks to develop new techniques—both seismic and nonseismic—for the detection, discrimination, [deleted] of nuclear events and activities.

Verification and control technology

	Millions
Base technology: Seismic wave generation/propagation; ionospheric monitoring; infrasonic monitoring; space radiation characterization	$11.2
Applications: Satellite instrumentation fabrication; seismic station fabrication	17.0
Operational support: Seismic network operation; on-site inspection; export control; arms control; proliferation; [deleted]; satellite support; program direction	20.7
Capital equipment	1.1
Total	50.0

Seismic base technology activities concentrate on how regional seismic wave generation and propagation are influenced by the properties of various types of geophysical structures and their source mechanisms.

The nonseismic program is exploring a number of advanced techniques for detecting [deleted] underground nuclear explosions.

[Deleted.]

APPLICATIONS

The applications component of the Verification and Control Technology Program provides the necessary hardware and the production capability for nuclear explosion detection and for satisfying treaty monitoring requirements. The requested funding for the applications component is $17 million, an increase of $1 million.

The most significant effort in fiscal year 1982 will be [deleted] for spaceborne nuclear detection sensor systems, a role which traditionally has been unique to DOE and its predecessor organizations. The DOE program has a two-fold purpose. One is to provide the sensor subsystems essential to maintaining a nuclear test detection capability in the atmosphere and space in response to Safeguard (D) of the Limited Test Ban Treaty. The other is to provide the sensor subsystems needed for [deleted].

In the seismic area, the applications activity will focus primarily on the analysis and development of [deleted] regional seismic system configurations. This effort is aimed at enabling the Regional Seismic Test Network, which is being deployed under the operational component of the program, to operate under various technical configurations [deleted].

OPERATIONS

The operational component of the program provides for technical systems installation integration. maintenance, and calibration and testing of deployed systems and supports the evaluation and analysis of data collection, processing, and exploitation activities. It also supports all analytical activities in intelligence, arms control, and export control. The requested funding level for this component is $20.7 million, an increase of $5.5 million.

In the area of nonproliferation, DOE has a unique role since, as the manager of the U.S. nuclear weapons program, it has the most intimate and detailed technical knowledge of nuclear weapons requirements that apply both to weapon states and potential proliferating nations. DOE serves as a principal technical contributor to U.S. arms control activities through membership on the U.S. delegations to the Comprehensive Test Ban negotiations and in other international forums.

[Deleted.]

Another element of the operations component is proliferation intelligence analysis, which directly supports requirements of the Nuclear Non-Proliferation Act of 1978 and DOE responsibilities under Part 57b of the Atomic Energy Act for controlling nuclear technology exports. [Deleted.]

Significant operational support costs are incurred within the satellite instrumentation program for integration of sensor subsystems with launch and platform, and for program-unique test equipment. The operational support component also provides resources for the maintenance and readiness of the equipment and personnel necessary to fulfill provisions of the not-yet-ratified Peaceful Nuclear Explosions Treaty (PNET). The DOE maintains the national capability for onsite placement of monitoring teams and equipment should the Soviet Union invoke the applicable provisions of the PNET. This equipment, maintained at the

Nevada Test Site, would be deployed to insure the peaceful character of an explosion and to assure that the yield does not exceed treaty limits.

General and specific analytical activities, mandated by legislation, regulation, *and Executive Branch guidance, directly support the export control function of* the Department, international exchange responsibilities of the Department, the DOE nonproliferation program, arms control negotiations and initiatives, and Department and national intelligence requirements. The total request for these mandated activities is $5.9 million.

With regard to the export control function of the Department, the Office of International Security Affairs supports the Departmens of Sate and Commerce and the Nuclear Regulatory Commission, as well as implementing DOE regulations 10 CFR 810 which concerns special nuclear materials.

These activities are based upon the Export Administration Act of 1979, the Nuclear Non-Proliferation Act of 1978, the Atomic Energy Act, and other legislation and regulations. The Office is also working closely with the DOD in developing a list of militarily critical technologies, as mandated specifically by the Export Administration Act of 1979, to serve as the basis of future export regulations to be developed in cooperation with the Department of Commerce.

[Deleted.]

Operation of the Regional Seismic Test Network (RSTN) is another element of this component. This array of seismic station will help demonstrate the utility of regional seismic monitoring in nuclear test verification and will be the principal source of regional seismic wave data to be used in the discrimination technique activity underway in the base technology program. Stations in New York, South Dakota, and at two sites in Canada will be emplaced to join an existing station in Tennessee to form the RSTN. The entire RSTN system is scheduled to be fully operational in early fiscal year 1982.

CAPITAL EQUIPMENT

Capital equipment expenditures support research, development, test, and production activities through the provision of test equipment and instrumentation related to the total program. The fiscal year 1982 request is for $1.1 million which reflects an increase of $0.3 million over the fiscal year 1981 level.

Now, I will discuss the safeguards and security program request, including funds for security investigations.

NUCLEAR MATERIALS SECURITY AND SAFEGUARDS

The fiscal year 1982 budget request for nuclear materials security and safeguards is $48 million, an increase of $0.8 million over the amount authorized in fiscal year 1981. Fiscal year 1982 funds provide $4 million for program direction, primarily personnel costs of both security investigations and security and safeguards programs; approximately $0.7 million for independent assessments; $3.7 million for capital equipment; and approximately $39.6 million for operating expenses for the following activities:

NUCLEAR MATERIALS SECURITY AND SAFEGUARDS, FISCAL YEAR 1982 AUTHORIZATION REQUEST

[In millions of dollars, fiscal years]

	Estimate 1981	Estimate 1982	1982 increase/decrease over 1981
Nuclear materials security and safeguards:			
Operating expenses:			
Protect classified information	2.5	2.5	
Protect DOE weapons, facilities and SNM	24.1	24.0	−0.1
Respond to security emergencies	4.3	5.0	+.7
Support nuclear nonproliferation	8.1	8.1	
Assessments	.6	.7	+.1
Program direction	4.2	4.0	−.2
Total operating expenses	43.8	44.3	+.5
Total capital equipment	3.4	3.7	+.3
Total nuclear materials security and safeguards	[1] 47.2	48.0	+.8

[1] Includes pay raise supplemental of $476,000.

PROTECT CLASSIFIED INFORMATION

The first major goal of the program is to prevent unauthorized disclosure, theft, destruction, or loss of classified matter. Major emphasis has included formalization of a DOE Operations Security (OPSEC) program with planned intensified efforts in the area of counterintelligence, computer security and audiocountermeasures. This program provides field assistance in the form of operating security surveys and technical support. We are requesting $2.5 million plus associated equipment costs for these activities in fiscal year 1982.

PROTECT DOE WEAPONS, FACILITIES, AND SNM

The second major goal of the program is to support the protection of DOE facilities and the control and accountability for nuclear weapons, components, and special nuclear materials to minimize the success of possible malevolent acts which could impact national security and DOE operations. We are requesting $24 million plus associated equipment costs for these activities in fiscal year 1982.

This area encompasses our major research and development efforts. Emphasis is being given to improved methods for detecting and controlling access of personnel to the facilities and special nuclear material (SNM) through development and use of automated equipment.

Fiscal year 1982 work will continue on development of advanced instruments and techniques to measure special nuclear materials (SNM) more rapidly and accurately with reduced exposure of operating personnel. Supporting activities on standards and reference materials for calibration purposes and enhanced measurement quality will also continue. Additional attention is being given to improving safeguards measurement capability for scrap and waste and for U/Pu fuel compositions and forms such as would exist in storage, fabrication, and reprocessing operations. These efforts will serve to minimize inventory differences and enhance our ability to detect attempted thefts or diversions.

The New Brunswick Laboratory (NBL) located at Argonne National Laboratory serves as the Safeguards Analytical Laboratory, providing nuclear measurements support to DOE programs and evaluating the measurement performance of DOE laboratories.

NBL also plays a lead role in developing standard reference materials and measurements procedures and provides similar services to the Nuclear Regulatory Commission on a reimbursable basis.

Additionally, we will continue to develop improved components and systems to provide positive means for control of personnel access to key facilities and to special nuclear material to protect against theft or diversion of material or sabotage. This will include intrusion detection equipment which is more sensitive and less susceptible to false alarms; more reliable and sensitive devices to detect SNM, explosives, or other objects that might be used illegally; and automated equipment for personnel identification and control.

Our fiscal year 1982 facility systems implementation activities will build on current efforts for developing integrated safeguards systems and on technology developed in component and systems research and development. A new implementation task involves the application of previously developed national spent fuel storage system design and associated equipment in preparation for a possible new facility. In systems research and development, we are developing facility system concepts and technology for: near real-time nuclear material accounting, performing trade-offs between different portions of systems, systems evaluation, and improving guard roles and training.

The systems implementation effort provides direct safeguards and security expert assistance to field offices and DOE facility managers to help them assure that DOE's facilities have adequate safeguards and security systems. The systems implementation program in 1982 will support safeguards improvements at eight major DOE facilities, as well as provide support to eleven smaller DOE facilities. These implementation support tasks provide direct support toward upgrading existing systems, establishing new systems and procedures, and identifying deficiencies in existing equipment.

RESPOND TO SECURITY EMERGENCIES

The third major goal of the program is to minimize adverse consequences resulting from malevolent acts or threats involving DOE activities and to provide assistance to other agencies in responding to malevolent nuclear acts or threats potentially affecting the U.S. public. We are requesting $5 million and associated equipment costs for these activities.

In fiscal year 1982 we expect to complete a comprehensive evaluation of the vulnerability of different nuclear facilities for various types of adversary actions and to apply the results of threat analysis to the safeguard and security requirements at DOE facilities. Research on the insider will be completed and techniques to effectively minimize the impact of this type of adversary actions against DOE facilities will be developed.

The incident management program is dedicated to research and development of a more sophisticated capability for the comprehensive rapid assessments of nuclear and non-nuclear threats to DOE facilities and assets. This capability is intended to provide rapid and accurate evaluation and response to those incidents including terrorist acts, extortion attempts, and bomb threats. Training of personnel and ongoing evaluation and upgrade of resources are an integral part of this research and development program, as is the provision of secure reliable communications and logistics support.

SUPPORT NUCLEAR NONPROLIFERATION

The final major goal of our program is cooperation with our Federal agencies in implementation of U.S. nuclear nonproliferation policy. We are requesting $8.1 million and associated equipment costs for these activities.

The DOE safeguards and security program augments and assists in safeguards at U.S. or foreign fuel cycle facilities either under the auspices of the IAEA, Euratom or through an agreement with host countries. Results of the DOE program are shared with other countries and international organizations in efforts to help them protect all nuclear materials against diversion or misuse.

Training activities are mandated by the Nuclear Nonproliferation Act of 1978 (Section 202). Training in 1982 includes two courses in nuclear material safeguards and security for persons from other countries or from international organizations in cooperation with the International Atomic Energy Agency.

ASSESSMENTS

A program conducting independent reviews of the effectiveness of protective systems for activities of importance to the national security is in place under my direct supervision. Using recognized experts, revews are conducted at field offices and senstive DOE facilities. Results are reported directly to me. The budget requests for these activities in fiscal year 1982 is $0.7 million.

CAPITAL EQUIPMENT

We are also requesting $3.7 million for capital equipment. These funds will provide the capital equipment required for test and operational evaluation of the safeguards systems modules mentioned earlier.

Now, I will move on to the security investigations.

SECURITY INVESTIGATIONS

One of our major responsibilities is to provide security investigations for personnel, who, must have access to Restricted Data, National Security Information, Special Nuclear Material, or who occupy designated Critical Sensitive positions. These investigations are performed for the Department by the FBI and the Office of Personnel Management.

SECURITY INVESTIGATIONS, FISCAL YEAR 1982 AUTHORIZATION REQUEST

[In millions of dollars, fiscal years]

	Estimate 1981	Estimate 1982	1982 increase/ decrease over 1981
Security Investigations:			
Operating expenses:			
FBI investigations	1.5	2.8	+1.3
OPM investigations	13.9	20.7	+6.8
National agency checks	.1	.1	
Total security investigations	15.5	23.6	+8.1

The fiscal year 1982 budget request for Security Investigations is $23.6 million, an increase of $8.1 million over the amount authorized for fiscal year 1981. These funds will support:

1,760 full field investigations to be conducted by the FBI. This is an increase of 250 over fiscal year 1981. The cost per investigation for an FBI full field investigation in fiscal year 1982 is approximately $1,600.

15,905 full field investigations and 10,650 National Agency Checks to be conducted by the OPM. This is an increase of 5,325 full field investigations and 480 National Agency Checks over fiscal year 1981. The cost per investigation for an OPM full field investigation in fiscal year 1982 is approximately $1,300. The cost for a National Agency Check is small ($9).

The bulk of the security investigations conducted for the Department supports the weapons program and the uranium enrichment program.

This concludes my prepared statement. I will be pleased to answer any questions you may have.

MARK 12A PRODUCTION

Senator WARNER. This committee amended the fiscal year 1982 DOD procurement bill to keep open the production line on the MK12A. Senator Jackson sponsored this amendment. It is his intention to retrofit the remaining [deleted] Minuteman III missiles with W-78 warheads.

Can the Department make the warheads to accommodate this change?

Mr. CULPEPPER. Mr. Chairman, the time frame that we understand has been discussed falls within the [deleted].

Senator WARNER. Dr. Wade, what is the impact of forcing the Department of Energy to build the additional W-78 warheads?

Dr. WADE. Mr. Chairman, let me state what I think are the more important pieces of a rather complex issue:

As Jim Culpepper mentioned, we do have the problem of availability of special nuclear material. As you are aware, we are turning on additional capacity to improve the availability [deleted].

Second, the Department of Defense is currently reviewing [deleted]. We are reviewing that at this time and we hope to have the decision in the next several months.

The third issue is one that has been on us for about 12 months; that is, what should be our force structure in the outyears? For example: How many Minuteman III's do you want vis-a-vis the Poseidon system under SALT I constraints? We have a new bomber coming on line. What is the load-out on the bomber? How many artillery fired atomic projectiles do we require in the theater nuclear areas? The question of special nuclear material impacts on these issues, too.

To answer your question, in sum, the continuation of MK12A beyond that currently programed is not truly cost effective.

We expect to have some of these decisions completed within the Department over the next 3 or 4 months. Keeping the option open through the authorization bill may be [deleted] and could come back to the Congress after our analysis is done and suggest to you either that we need to maintain that line or we could reprogram the moneys elsewhere.

I would hope that if the committee feels that continued MK12A production is appropriate, the options we have recommended to the committee on other programs should not be shifted, in the sense of putting MK12A continuation at a higher priority.

If it is an add-on, I strongly support the authorization approach here; but in the sense of where it fits in the cost-effective sense of the whole DOD program I would recommend otherwise.

Senator WARNER. Senator Jackson's staff wishes to have made a part of the record the following: That Senator Jackson is not predicating the Minuteman III retrofit on the [deleted].

Dr. WADE. Yes, sir.

Senator WARNER. Then the question arises, do we have to add money to the DOE budget to protect that?

Mr. CULPEPPER. Mr. Chairman, I don't think so at this time for fiscal year 1982. Certainly, if we are going to carry through with this, as Dr. Wade mentioned and I said earlier, [deleted].

I don't think we are in a position to identify that to you at this point. I do not think at the moment we are able to identify the additional fiscal year 1982 money that will be required.

NUCLEAR WEAPON STOCKPILE REPORT

Senator WARNER. Mr. Morgan, your statement touches briefly on the nuclear weapons stockpile memorandum and the process whereby the President approves the nuclear weapons production plan.

As I understand it, this memorandum is not made available to the Congress. In lieu thereof, we have requested a report summarizing the nuclear weapons stockpile, and your budget request in terms of its ability to meet production schedules. That report is very important to our deliberations and was due on March 1 of this year. Can you advise us as to the status of the report to the Congress?

Mr. CULPEPPER. Yes, sir, we have worked very closely with the Department of Defense. We did notify Senator Tower earlier that due to President Reagan's budget being submitted on March 10, we would not be able to meet the March 1 date, but that the report would be submitted as soon as possible. It is in final preparation. I think it is now with the DOD for their signoff. I anticipate it will be to you very shortly.

Mr. MORGAN. Mr. Chairman, I might add that the text of that March 1 report is completely agreed to between DOD and DOE, and it is a matter of delivery at this point.

NUCLEAR MATERIAL PRODUCTION CAPACITY

Senator WARNER. Mr. Morgan, what steps have you taken to insure you have a sufficient supply of special nuclear materials to meet the production requirements in the middle 1980's?

Mr. MORGAN. The initiatives that we have taken to date are the upgrade of the L reactor at Savannah River for subsequent restart, and the startup of the Purex facility at Richland, which will process the N reactor fuel.

In addition, we have converted or are converting the N reactor from 12 percent plutonium-240, which is a fuel-grade material, converting that to operating at 6 percent, which is a weapon-grade material.

We are looking at other alternatives, such as the special isotope separation work and different loadings in the reactors at Savannah River that could possibly further increase our production.

The other thing is the restoration money that we have requested to insure that the facilities will operate at their optimum.

Senator WARNER. Are you confident that these initiatives can provide the needed materials, or are there other initiatives that would provide a hedge against any uncertainty?

Mr. MORGAN. The current initiatives that we have started [deleted].

Senator WARNER. Dr. Wade?

Dr. WADE. Mr. Chairman, the Department of Defense is still seriously concerned about the capacity of DOE to provide out-year requirements.

It is important to note here that we have initiated a development program. Although it is not cited in the latest nuclear weapons stockpile memorandum for the DOD, to spend the money that is now in that program and not have protection from DOE to provide the additional material, is a cause for concern.

You will recall I testified last year, noting the important policy statement that we should not be overly restrained in how we plan our forces by the availability of special nuclear material. We are working hard with the DOE, and in particular we need to have firm contingency plans to be able to cover the situation in case the Department of Defense has an urgent need and the urgent need is spelled out in a hurry.

Senator WARNER. Gentlemen, time constraints on me are such that I have to attend to other matters at this time. Therefore, I will submit the balance of my questions for the record.

[Questions with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR JOHN W. WARNER

Senator WARNER. Dr. Sparks, each of you is a prominent scientist in his own right. I know you have prepared some remarks to be delivered here this morning and they will be included in the record. But for a moment I would like for you each to list the two or three things—in the nuclear systems area—that you feel should be of primary importance to the Armed Services Committee as it performs its duties. Your ideas are welcome in the areas of nuclear weapons research and development, weapons production, weapons modernization, arms control, or any other allied field. I will ask each of you in turn to discuss your number one priority and then we will go through again for your number two and number three priorities.

Dr. SPARKS. My first three priorities for the weapons program were covered in my testimony this year. In fact, my first priority was also the theme of my testimony last year; that is, the updating of the safety and control technology in the stockpile—what we have called the Stockpile Improvement Program. My second priority is returning weapons research and development funding to a reasonable level and maintaining that level of effort. Thirdly, I would list the upgrading of the research and development and production facilities to return them to a reasonable state of health. This would require continued funding of construction and capital equipment restoration.

Senator WARNER. We need some new thinking in the arms control area. Salt II was so complex that it had little chance of success. How do we get at arms control—how can we put some cap on this nuclear genie and start to make sensible reductions?

Dr. SPARKS. For over a decade we have pursued new arms control agreements, believing that these agreements in themselves would reduce tension and foster international cooperation. At times, we seem to have substituted arms control negotiations for strategic weapon improvements in the mistaken belief that security can be purchased at a bargain price. Events have failed to confirm our hopes and I believe that future arms control initiatives will need to be formulated carefully to ensure that treaties are compatible with our national security. Otherwise, they will not serve their intended purpose of reducing tension and enhancing stability. That means that we must enter the negotiating process with a clear understanding of our national security requirements. SALT I and SALT II were domestically controversial because many believed that our basic security interests were not protected. Part of the problem may have been that our initial negotiating position was formulated on what the military considered lowest acceptable levels. Each concession we made during negotiations diminished that established minimum, which understandably concerned the military. And it follows that treaties tend to be unstable if our military experts make us uneasy about the military balance of power.

Another important facet of any treaty is whether its provisions can be verified. If a treaty cannot be adequately verified, disagreement about whether both parties are complying with the treaty will undermine the spirit of cooperation. Thus, it is important to pursue the technologies that make verification possible or easier. In earlier treaty negotation, we encountered several situations where verification technology significantly affected treaty proposals and the negotiating process.

In spite of my hopes and wishes to the contrary, I don't think that we will achieve a world free of weapons of mass destruction in the foreseeable future. Unless such a world has adequate international safeguards, it tends to be unstable because any nation that cheats with a very small number of weapons can blackmail the rest of the world. And international safeguards have been difficult if not impossible to reconcile with national sovereignty. I don't expect that to change for a long time. In spite of that dilemma, we can make progress incrementally, even if the Soviets continue their propaganda campaign for general and complete disarmament. If we try to achieve impossible goals we will achieve nothing, but we can make progress if we aim for reasonable goals. For instance, I believe the Limited Test Ban Treaty has been a good treaty, because it is verifiable and because it approached the question of testing in an incremental mode.

In summary, I believe that arms control negotiations should be pursued in a spirit which encourages mutual trust and a mutual desire to reduce tension. From our point of view, this means that we must negotiate from a position of basic military equality, if not superiority. We need to resist domestic pressures to sign treaties for their own sake. Premature hopes of pushing the nuclear genie back into its bottle will only hurt our defense without any compensating benefits.

Senator WARNER. Dr. Batzel, each of you is a prominent scientist in his own right. I know you have prepared some remarks to be delivered here this morning and they will be included in the record. But for a moment I would like for you each to list the two or three things—in the nuclear systems area—that you feel should be of primary importance to the Armed Services Committee as it performs its duties. Your ideas are welcome in the areas of nuclear weapons research and development, weapons production, weapons modernization, arms control, or any other allied field. I will ask each of you in turn to discuss your number one priority and then we will go through again for your number two and number three priorities.

Dr. BATZEL. There are two issues which I feel deserve high priority consideration—safety and security of nuclear weapons and advanced research and development. In my view, both issues are of equal and high priority and can well justify additional support.

SAFETY AND SECURITY OF NUCLEAR WEAPONS

Safety and security issues of nuclear weapons are an integral part of the nuclear explosive program at the Lawrence Livermore National Laboratory (LLNL). While LLNL scientists and engineers have always devoted considerable effort to provide increased weapons safety and security, they continue to seek improvements. Weapons with improved safety and security features are being introduced into the stockpile, and new designs are being tested and developed.

Recent work in this area has focused on an important area of nuclear weapon safety; minimizing the probability of plutonium dispersal in accidents. [Deleted] the Titan II missile explosion on September 19, 1980, near Little Rock Air Force Base, Arkansas.

[Deleted.]

The Titan II accident provides an unfortunate example of the kind of accident which can occur in our silo-based ICBM force. The Titan II's warhead was blown off the exploding missile and landed alongside the access roadway. This warhead used cyclotol explosive which is more difficult to detonate in an accident environment (and also less energetic) than the high explosives conventionally used in modern warheads. Calculations indicate that the estimated impact velocities generated in the Titan accident were in a range sufficient to detonate currently used high explosives. Had a modern warhead without enhanced safety features been deployed on Titan, plutonium dispersal would have been likely. In this sense, the Titan accident constitutes an unfortunate but "operational" test of the utility of insensitive high explosive.

Because of the potentially damaging consequences of a plutonium dispersal accident in terms of its hazard to humans, disruption of normal activities at the accident site, costly clean-up activities, and public reaction, LLNL has vigorously pursued the inclusion of enhanced safety features on all new military systems where possible. Modern enhanced safety features have been or are being included in the following weapon systems; the B61 bomb, the Air Launched Cruise Missile (W80), the B83 bomb, the Ground Launched Cruise Missile (W84), the Pershing II (W85), and the Advanced Ballistic Reentry Vehicle (ABRV) for M-X. These weapons reduce the probability of plutonium dispersal in impact accidents by the use of insensitive high explosive.

Insensitive high explosive has been operationally tested and has shown exceptional promise for eliminating the risk of high explosive detonation (and subsequential dispersal of plutonium) in accidents such as missile booster explosions and high velocity aircraft crashes. Utilization of insensitive high explosive in modern bombs will [deleted] reduce the potential hazards of carrying nuclear weapons aboard alert-configured B52s. Deployment of the ABRV with its enhanced safety features will reduce the potential hazards involved with the movement of the M-X missile between protective shelters.

ADVANCED RESEARCH AND DEVELOPMENT

[Deleted.]

Senator **Warner**. We need some new thinking in the arms control area. SALT II was so complex that it had little chance of success. How do we get at arms control—how can we put some cap on this nuclear genie and start to make sensible reductions?

Dr. **Batzel**. There have been many ideas and proposals aimed at reducing the threat and destructiveness of war in general and nuclear war in particular. None has been an undisputed success. One general approach is an attempt to control military technology and its development. This has proven difficult because technology is driven by a variety of programs—some military, some civil. While control of military programs may be possible in principle, civil programs are less subject to restraints. Furthermore, the development of an idea may be delayed by formal proscription but, when the idea is ripe, it breaks out in a variety of directions. Also, treaties to control and suppress technology are difficult to monitor and verify and typically would not lend a stabilizing influence to arms competition over the long term.

During the 70's, there were a number of arms control treaties that were pursued and some of these are now in effect. I believe that most of these efforts served a useful purpose in improving US-Soviet relations. The fact that a particular treaty was important in managing US-Soviet relations in the 70's, however, does not automatically mean it will be as useful in the 80's. One example is the ABM treaty of 1972 which limited ABM's at a time when their introduction, from a military hardware point of view, was considered to be less important than the political benefit of reaching an arms control agreement. Today, however, to strengthen mutual deterrence we are looking for a means to enhance the survivability of our ICBM's, the land-based element of the strategic Triad. No easy solutions are apparent.

The use of an ABM to protect the ICBM's, whether in conjunction with an M-X deployment or not, might provide increased survivability. I am not recommending that ABM's be deployed at this time, but I think that we should keep our minds open to the possibility that the ABM treaty could be modified to allow a missile defense ABM system whose purpose would be to increase the military stability of the US-USSR relationship.

I think it is important to review with you my position on a Comprehensive Test Ban (CTB) treaty. As you are aware, I have testified that, under a CTB, we would not guarantee the long-term reliability of our stockpiled nuclear weapons, nor could we develop new weapons having features that are highly desirable from the standpoints of safety, security, economy, and effectiveness. New weapon designs are not typically of ever-increasing yield, rather they are usually sophisticated devices which would limit indiscriminate damage. My views on the CTB have not changed. I still believe that a CTB would not allow us to carry out our responsibilities in the nuclear weapon field. I would also like to add that an agreement limiting test yields to less than the 150 kt now being followed would have some of the adverse impacts of a CTB and certainly would be an undesirable direction to move from the point of view of maintaining a modern and reliable nuclear deterrent force.

Senator **WARNER**. Dr. Robinson, each of you is a prominent scientist in his own right. I know you have prepared some remarks to be delivered here this morning and they will be included in the record. But for a moment I would like for you each to list the two or three things—in the nuclear systems area—that you feel should be of primary importance to the Armed Services Committee as it performs its duties. Your ideas are welcome in the areas of nuclear weapons research and development, weapons production, weapons modernization, arms control, or any other allied field. I will ask each of you in turn to discuss your number one priority and then we will go through again for your number two and number three priorities.

Dr. **ROBINSON**. Regarding the request for supplemental information in response to two questions by the Senate Armed Services Committee, I addressed these subjects during the testimony, and during the question and answer period. However, I have supplemented those remarks with the statements below:

Priority 1.—First priority is the maintenance of a strong technical capability in nuclear weapons research, development, and testing. As long as we rely on nuclear weapons for our first line of defense, it is essential that all stockpile weapons perform in a reliable manner, and that we have available the best technology in our deployed nuclear weapons systems. The so-called Augmented Test Program will be a very positive step following a decade of funding decline for nuclear weapons research and development. But continuing strong support will be required if we are to truly rejuvenate the nation's nuclear weapons capabilities.

Priority 2.—It is important that we not focus exclusively on nuclear weapons offensive capabilities, but that we broaden investigations to include all those technological developments that could threaten the value of nuclear weapons as a deterrent. While we should investigate anti-ballistic missile technologies to see what value they could be in protecting our offensive capabilities, it is equally important that we ascertain the potential for use of anti-ballistic missile technology by our enemies.

Priority 3.—Limitations on nuclear testing in the current threshold test ban treaty are currently constraining our ability to develop the required nuclear warheads in significant ways. [Deleted.] We believe it is crucial to keep the overall national security goals in mind in considering the value of limitations on nuclear testing as an arms control issue.

Senator **WARNER**. We need some new thinking in the arms control area. SALT II was so complex that it had little chance of success. How do we get at arms control—how can we put some cap on this nuclear genie and start to make sensible reductions?

Dr. **ROBINSON**. Let me try in a couple of areas. First of all, I think the most important area for arms control would be in some appropriate strategic arms limitation, if we can decide what the quantity is that should be measured and achieve some numerical equivalence between the two sides. I do worry, as Dr. Batzel, about other areas we go into as arms control measures that we somehow box ourselves in.

Two particular examples that are timely for this committee. First, the reevaluation of the ABM Treaty in 1982, I think, requires some very careful thinking on your part as to how that really affects our overall defense posture. It was touted by many that if we built an ABM system, it would be destabilizing. I think we really have to look at that in terms of overall conditions. [Deleted.] I think, looking at our present position, one might decide that is one example of a treaty that may be hurting us and some type of modification might well be in order.

The other area, and one that directly affects the three of us, is in constraints on nuclear testing. Now we have found it hard for years to see how testing constraints are really an effective arms control measure. There are a number of analogies one can make. I would assume that nuclear testing is itself a requirement for a stable condition under a strategic arms limitation agreement. If we say we are going to have a certain number of weapons on either side, it is assumed implicitly that those weapons are going to work and, if one cannot guarantee the operability of those weapons, I think it is a very unstable condition.

The particular limitation to yield, I believe, is up to 150 kilotons. If we remember, in 1974 when that was approved, both the Atomic Energy Commission and the Department of Defense and each of the services said that was too low a yield.

Now we are operating under that treaty, though it has not been ratified by the Senate. Should that come to pass, I think one should ask some very careful questions—not only, what does it do to the guarantee of our existing stockpile that something has not gone wrong with it. As you know, there are [deleted] weapons systems that cannot be tested today at full yield because of that treaty.

You should ask how does this box us in against future technologies? Where are the areas of technology we cannot investigate because of that yield limitation?

The laboratories have been investigating that question the past year based on having lived with this treaty for sometime now, and have prepared a draft for the Department of Energy that indicates there are a number of technological areas at risk because we cannot test at higher yields.

DOE PERSONNEL

Senator **Warner**. Are you operating under any personnel recruiting constraint?

Mr. **Morgan**. Yes. The Department is operating under a reduced manpower ceiling set by OMB. Within DOE, manpower utilization plans for fiscal year 1981 and fiscal year 1982 are being developed for allocation of this new lower ceiling among the several DOE programs. Until these new staffing plans are complete, the hiring limitation imposed by the President will continue.

Senator **Warner**. DOD is not under a personnel hire limitation. Have you asked for relief from this limitation?

Mr. **Morgan**. No. At present we are undergoing a detailed and extensive organizational review. If, at the completion of that review, it appears necessary to request relief from the hiring limitation, I will certainly do so.

NUCLEAR WASTE MANAGEMENT

Senator **Warner**. Would you briefly categorize defense nuclear waste and give the Committee some feel for the volume of each category of waste?

Mr. **Morgan**. Defense nuclear wastes are broadly classified into four categories. These are high-level waste (HLW), transuranic waste (TRU), low-level waste (LLW), and airborne waste (ABW).

Defense HLW results from the chemical processing of production nuclear reactor fuels. It is separated in the form of a radioactive, acidic liquid during the steps to extract and purify plutonium and uranium from the irradiated actinides which are not separated out during reprocessing. Because of the corrosive nature of the acidic HLW, it is made alkaline before storage in underground tanks at Hanford and Savannah River. After aging, cooling, and evaporation of excess water, the HLW consists of three fractions: liquid, crystalline salt cake, and sludge. At the Idaho facility, HLW is stored for short periods in stainless steel tanks, after which it is calcined to a dry granular solid and stored in bins. The present volume of defense HLW amounts to approximately 282,000 cubic meters.

Defense TRU waste is waste material containing transuranic elements, mainly plutonium and uranium-233 in excess of 10 nanocuries per gram of waste. TRU includes chemical process residues, discarded equipment and tools, paper, clothing, glass and contaminated soil. Prior to 1970, about 332,000 cubic meters of TRU were buried. Since 1970 TRU waste has been stored in engineered facilities. The waste is retrievable for at least 20 years after storage, so that it can ultimately be recovered and processed for disposal in a repository. Presently, about 55,000 cubic meters of defense TRU are in retrievable storage.

Defense LLW includes all radioactive waste that is not HLW or TRU. LLW is produced when radioactive materials are handled or processed, and consists of a variety of materials including trash, paper, plastics, protective clothing, discarded equipment, and liquids. Solid LLW is disposed of by shallow land burial. Liquids are solidified before burial. To date, DOE has disposed of about 1,780,000 cubic meters of defense LLW.

Airborne waste is gaseous waste contaminated with radioactive materials generated during nuclear material processing and handling activities. The gas is treated using techniques such as filtration and scrubbing. It is then monitored and released under controlled conditions or retained for further use. The existing regulations do not require DOE to capture and store the gaseous waste generated at DOE facilities.

Senator **Warner**. For each category of waste discuss briefly your current programs for the long term processing and disposition of the waste.

Mr. **Morgan**. The high level waste objective of the Department of Energy program for defense waste programs at Savannah River, Hanford, and Idaho, is to develop and select an option for each site, and to design, construct, and operate facilities for its implementation. Generic options for each site include continued long term storage on site, on-site stabilization, retrieval from tanks (or bins) and immobilization of the high-level waste for disposal in a geologic repository.

The current program concentrates resources on implementation of a long-term program at one site, the Savannah River Plant. The reference option is retrieval and immobilization in borosilicate glass for repository disposal. This includes construction of a Defense Waste Processing Facility. Construction of Stage I of the facility is expected to begin in fiscal year 1983. One alternative to borosilicate glass as a final waste form will be selected for intensive development in fiscal year 1982. The long-term programs at the other two sites will be deferred until the Savannah River program is well underway.

The shallow land burial of low-level waste is an established practice for the disposal of wastes generated from Department of Energy programs. The current program includes stabilization of waste burial sites and development of technology to protect public health and safety, meet applicable criteria and standards, and optimize the future low-level waste management system.

Transuranic wastes generated by Department of Energy programs are stored at six Department sites—Savannah River, Hanford, Idaho, Oak Ridge, Los Alamos, and Nevada. The long-term program strategy consists of: continue storage of defense transuranic wastes at Department of Energy sites; reduce waste generation; develop standards and criteria for disposal; develop technology and facilities for retrieval, processing, and immobilization; and select and implement a long-term option for transuranic wastes at each site.

The current program emphasizes implementation of a long-term program at only one site, Idaho. The reference option for stored transuranic waste at this site is retrieval, processing, and immobilization for repository disposal. A Transuranic Waste Treatment Facility has been proposed for the processing step and a full scale nonradioactive demonstration of the reference process being considered for this facility is supported in the fiscal year 1982 program.

The airborne waste technology development efforts for particulates and gaseous radionuclides include improvement of filter life and recorvery methods, development of immobilization into a stable form, and storage and/or disposal of packaged waste. A pilot scale demonstration of an integrated off-gas treatment system is expected by 1990.

Senator **Warner**. What is the administration's position on the Waste Isolation Pilot Plant project? How much money is in your budget for fiscal year 1982 to proceed with this facility?

Mr. **Morgan**. The fiscal year 1982 budget submitted by the Reagan administration provides funding of $48.7 million to allow the project to be continued in accordance with congressional direction. Fiscal year 1981 funds, which were deferred by the previous administration have also been released so construction of the initial exploratory shaft can begin this summer.

Senator **Warner**. What is your position on the Defense Waste Processing Facility at Savannah River? How much is in your fiscal year 1982 budget for this project and what is the total projected cost?

Mr. **Morgan**. Savannah River Operations Office has completed the conceptual design for the Defense Waste Processing Facility, which will treat Savannah River high-level waste and prepare it for shipment to a repository. Plant Engineering and Design funds of $10 million requested in fiscal year 1982 will continue preliminary design activities associated with Stage I of this facility. Stage I which will provide solidification of the sludge portion of the waste, has a projected cost of $850 million in construction funds and $200 million in operating funds. Our plans are to begin construction in late 1983. Stage II of this facility which will treat the salt, is currently being designed and construction is anticipated to start in about 1986.

Senator **Warner**. What is your position on the TRU waste processor at Idaho Falls? How much is in your fiscal year 1982 budget for this project and what is the total projected cost?

Mr. **Morgan**. We are still looking at several alternatives to the Slagging Pyrolysis Incineration system for the Transuranic Waste Treatment Facility and we have not yet arrived at a definite position. For fiscal year 1982, we will be spending $7.4 million for studies of the alternatives and a slagging pyrolysis incinerator nonradioactive demonstration. The leading alternative (which would use existing technology to provide for a facility capable of processing 70 to 95 percent of the transuranic waste stored at INEL) has a projected total estimated cost of about $350 million.

ENHANCED RADIATION WEAPONS

Senator **Warner**. Dr. Wade, perhaps you could comment on the administration's current plans for deploying these enhanced radiation warheads?

Dr. **Wade**. To date no decision has yet been made on either production or deployment of enhanced radiation weapons. We are keeping all of our options open. The Administration has been conducting an interagency review of the question of production and deployment of enhanced radiation weapons. That review is moving along satisfactorily.

Senator **Warner**. You are now about to go into production of the Lance warhead and the 8-inch artillery warhead which can include an enhanced radiation capability. Would you discuss briefly this enhanced radiation feature?

Mr. **Morgan**. The enhanced radiation feature which can be incorporated into the W70 warhead for the Lance missile system and the W79 warhead of the 8-inch artillery fired atomic projectile is [deleted] produce a large quantity of energetic neutrons, which give the enhanced radiation weapons the capability of killing the crews of armored vehicles such as tanks. Compared to standard fission nuclear weapons, which rely upon their blast effects to destroy tanks, enhanced radiation weapons can be employed in much smaller, approximat[illegible] tenth, yields and still achieve the desired military effects. The de[illegible] hanced radiation weapons' blast and thermal effects, again[illegible] weapon of the same overall effectiveness, will allow them [illegible] in closer proximity to friendly units or civilian-inhabited areas [illegible] radiation feature, thus, should reduce unintended damage and casualties among civilians.

[Deleted.]

Senator **Warner**. What are your current plans with regard to producing the necessary materials and components in order to be able to incorporate the enhanced radiation capability at some point in the future?

Mr. **Morgan**. [Deleted].

INERTIAL FUSION

Senator **Warner**. Briefly explain the goals of your Inertial Confinement Fusion program.

Mr. **Morgan**. Inertial Fusion (IF) is of interest both for military applications and as a potential source of fusion energy. In the near term, the principal goal of the IF program is to determine the full potential of inertial fusion for nuclear weapons physics applications. The development of an economic and practical energy source lies further in the future.

Senator **Warner**. I understand that your budget amendment reflects a significant reduction in funding from the original Carter budget for fiscal year 1982. What was the original Carter request for the ICF program for fiscal year 1982? What reduction did you make and why?

Mr. **Morgan**. The original Carter budget, comparable to the present Inertial Fusion budget, provided $219,200,000. The Inertial Fusion budget was reduced to $180,200,000. This cut reflects a rescoping of the Inertial Fusion program to concentrate on obtaining a R&D deliverables utilizing current facilities and facilities under construction. The objective is to determine the potential of inertial fusion as an energy source for weapons physics and commercial energy applications. This R&D doesn't presently envisage the construction of larger laser facilities. The reduction also reflects the best prioritization of funding between inertial fusion and other Defense programs within budgets.

REPLACEMENT PRODUCTION REACTOR

Senator WARNER. Last year in its report on the fiscal year 1981 authorization bill this committee strongly urged you to proceed with the planning for one or more replacement reactors after receiving testimony that the reactors now operating at Savannah River would exceed their expected life in the early 1990's. Where do you stand on this effort; how much is in your fiscal year 1982 budget for this purpose; and what is your current schedule to get a new replacement production reactor into operation?

Mr. MORGAN. We are now in the process of compiling a data base on seven different concepts for replacement reactors. This compilation is scheduled for completion this spring, and concept and site selection is scheduled in fiscal year 1982. Approximately five million dollars has been requested for fiscal year 1982 RPR efforts. A tentative schedule for the first replacement reactor is as follows: Assessment of alternate production facilities, fiscal year 1981–1982; engineering design, fiscal year 1982–1987; initiate construction, fiscal year 1987; complete construction, fiscal year 1993; operational checkout, fiscal year 1993–1994; initiate full-power operation, fiscal year 1995.

LASER ISOTOPE SEPARATION

Senator WARNER. Would you briefly summarize the concept of producing nuclear material—plutonium and enriched uranium—by means of laser isotope separation.

Mr. MORGAN. I would like to remind you, Senator, that Laser Isotope Separation (LIS) processes cannot produce plutonium. They can, however, process plutonium [deleted] to make it suitable for weapons by separating out some of the undesirable plutonium isotopes.

Two LIS technologies are being evaluated for [deleted] uranium enrichment: Molecular Laser Isotope Separation (MLIS) and Atomic Vapor Laser Isotope Separation (AVLIS).

In the MLIS process, [deleted] frequency can be adjusted so that only a molecule containing the selected isotope of uranium [deleted] will be excited by the laser. A second laser is then used to dissociate the excited molecule. The dissociated product will be a solid [deleted] which can be physically separated from the remaining gas. If the process is successful, the dissociated product will be highly enriched in the selected isotope.

In the AVLIS process, metallic uranium [deleted] is vaporized. Lasers are then tuned precisely so that a selected isotope of atomic uranium [deleted] will absorb the radiation. This leads to creation of an ion, which can be separated from the neutral vapor by electromagnetic means. If the process is successful, the ions created will be highly enriched in the selected isotope.

Senator WARNER. How much money have you included in your fiscal year 1982 budget to pursue this technology?

Mr. MORGAN. The fiscal year 1982 DOE Defense Programs budget includes $25.8 million in Budget Authority (B/A) for the plutonium Laser Isotope Separation (LIS) program. The fiscal year 1982 DOE Nuclear Energy budget includes $86.5 million in B/A for the uranium Advanced Isotope Separation technology program.

Senator WARNER. How mature is this technology? Are you confident that a pilot plant could be built now without further research?

Mr. MORGAN. Laser Isotope Separation (LIS) technology is not yet mature. There is much more experience with LIS using uranium than plutonium. For either material, further research, but mainly development and subscale demonstrations, will be needed before a plant could be built with confidence.

Senator WARNER. What are the proliferation issues surrounding this process?

Mr. MORGAN. We consider this enrichment technology sensitive and carefully control it. The classified Restricted Data technology is controlled by the Atomic Energy Act and any foreign access would require a formal Agreement for Cooperation such as we have with the United Kingdom on other defense matters. The unclassified unpublished technology is controlled by our regulation 10 CFR 810. We are very tightly controlling this technology because access to plutonium laser isotope separation would assist a country in developing a uranium enrichment capability. Also, while it would not create any new plutonium and all grades of plutonium could be useful as weapons material, [deleted]. This would reduce the radiation hazards in handling and fabrication as well as problems associated with weapon reliability and yield, making the proliferation task easier.

Senator **Warner**. Could this process be accelerated with increased funding?

Mr. **Morgan**. The current fiscal year 1982 funding of $25.8 million would enable DOE to demonstrate plutonium Laser Isotope Separation (LIS) technology on an engineering scale [deleted] by fiscal year 1985 and to have a plutonium LIS demonstration production plant on-line by fiscal year 1988.

Additional funding could accelerate the plutonium LIS engineering demonstration to fiscal year 1984 and the plutonium LIS demonstration production plant to fiscal year 1987.

Senator **Warner**. Is there a need to exempt L reactor and Purex from National Environmental Policy Act requirements?

Mr. **Morgan**. In light of the significant forecast demand for nuclear materails, I believe it is in the interest of the United States to assure that schedules are maintained for restart of previously operated facilities needed to support new nuclear materials production initiatives. I am concerned that procedures associated with the National Environmental Policy Act of 1969 could seriously jeopardize the schedules for resumption of operation of L Reactor and Purex.

The Department of Energy is committed to environmental protection. This includes environmental monitoring and the implementation of environmental control measures to assure compliance with applicable environmental requirements for our proposed actions, including the operation of L Reactor and Purex. As a practical matter, to assure that production from these facilities can be realized on planned schedules, I believe that an exemption from National Environmental Policy Act requirements would be beneficial. Such an exemption could be granted with the understanding that the Office of Defense Programs agree to prepare appropriate documentation to assure that potential environmental consequences are realisticaly considered and factored into the program.

I believe that such an amendment would satisfy concerns associated with assuring schedules for planned increased nuclear materials production while also assuring that these proposed actions conform to the basic intent of the National Environmental Policy Act.

PIPELINE SAFETY ACT

Senator **Warner**. We understand that the Pipeline Safety Act may have inadvertently eliminated language in Public Law 86–710(c) which unambiguously expressed Congress' intent to exempt from federal regulations escorted shipments of radioactive materials made by the DOE for national security purposes. We understand that Title 49 CFR Part 173.7(b) continues this exemption by regulation. Could you tell the Committee what the facts are here. What potential operating problems might this situation pose from the viewpoint of carrying out DOE's shipments of radioactive materials for national security purposes?

Mr. **Morgan**. The purpose of the Pipeline Safety Act was to improve the protection afforded the public against risks associated with the transportation of hazardous commodities by pipeline. This statute expressly repealed the older Transportation of Explosives Act which was first enacted prior to World War I, and which by later amendment exempted any shipments of radioactive materials made by the Atomic Energy Commission or the DOE that were escorted by personnel designated under the AEC's or DOD's authority for the purpose of national security.

The legislative background of the Pipeline Safety Act indicates that Congress considered the scope of the earlier statute to be outdated as a practical matter, and that in the wholesale repeal of that statute the elimination of the exemption for escorted security shipments by the AEC and DOD was an inadvertent result. This happened in November 1979, when 18 U.S.C. Sections 831 through 835 of the Transportation of Explosives Act were repealed by Section 216(b) of the Pipeline Safety Act of 1979 (Public Law 96–129).

As indicated, the repeal of Section 832(c) of the Act removed the statutory basis for the exemption from DOT regulation of shipments of radioactive materials made by the DOE or DOD for the purpose of national security.

The Section 832(c) national security exemption of the Act was stated as follows: Any shipment of radioactive materials made by or under the direction or supervision of the Atomic Energy Commission or the Department of Defense which is escorted by personnel specially designated by or under the authority of the Atomic Energy Commission or the Department of Defense, as the case may be, for the purpose of national security, shall be exempt from the requirements of sections 831–835 of this chapter and the rules and regulations prescribed thereunder . . .

Examples of the types of shipments would be nuclear weapons and components, special nuclear materials and fuel shipments for nuclear powered ships. So these shipments are important from the standpoint of national security. They have remained exempt from DOT generally applicable requirements by virtue of an express provision in DOT's regulations (49 CFR 173.7(b) and 177.806 (b)); in other words, exempt as a matter of DOT's discretion, rather than mandatorily by statute.

Of course, DOT is aware that DOE's safety standards and practices conform with the substance of DOT requirements. Over the years, a good working relationship has existed between DOT and our energy agency (and the DOD) in regard to safe transportation concerns and national security.

So long as the DOT regulations continue such an exemption for escorted DOE national security shipments we foresee no significant problems resulting from the loss of the former statutory exemption. If the regulatory exemption were to be lost or diminished somehow, however, whether due to a change of position by DOT or due to a court challenge regarding DOT's right to allow such exemptions, we could expect significant operating problems resulting in the following areas:

1. If DOE were required to comply with certain DOT regulations the movement of nuclear weapons could well be severely hampered. For example, the prohibition against combining Class A explosives and radioactive materials in a common shipment (per 49 CFR 174.81 and 177.844) might preclude further weapons shipments.

2. Prenotification of route requirements would greatly exacerbate shipment security efforts. It should be noted that to add to the protection of significant quantities of SNM, and nuclear pipeline reactor fuel shipments, the itineraries are considered "confidential" classified information.

3. Time-of-day restrictions on shipments into, around or through urban areas, whether imposed by outright transit delays (such as check points) or by mandatory detours would unnecessarily add time and expense, as well as unreasonably increasing the vulnerability of shipment to potential acts of terrorism.

4. Route designation authority at state and local levels could result in sensitive shipments being funneled through areas that we would prefer to avoid because they increase the opportunities for malevolent actions against the shipments.

5. Our experience has been good from the point of view of protecting the public health and safety with respect to these shipments. If important aspects of the shipment process were removed from DOE control, our concern would be that this excellent safety record might not be maintained.

Senator **Warner**. In defense programs you are responsible for the nuclear weapons, nuclear material production, and nuclear material safeguards programs. Do you feel that you have sufficient authority to prevent the release of information in these areas if release of the information could adversely affect the public?

Mr. **Morgan**. We do have authority to withhold certain information on nuclear programs classified as Restricted Data and Formerly Restricted Data under the Atomic Energy Act, and other information classified as National Security Information in keeping with current Executive Orders. However, we feel that there are additional areas of unclassified information which should not be released and for which the DOE does not currently have the unambiguous authority to protect. This information for example, concerns the safeguarding of nuclear materials and facilities, the production of special nuclear materials and the design or use of nuclear weapons and parts for those weapons. The release of some of the unclassified information could have adverse effects on the health and safety of the public or the common defense and security. It could facilitate the theft, diversion or sabotage of nuclear materials or facilities or the illegal production of special nuclear material or nuclear weapons. Last year NRC sought and obtained legislation to allow withholding of certain unclassified information within their area of responsibility, e.g. regarding licensee nuclear facilities (now Section 147 of the Atomic Energy Act). In our judgment, it would be highly advisable to at least conform DOE's authority in its areas of concern. Essentially, basic responsibility for common defense and security under the Atomic Energy Act rests with the Department and, ultimately, the President.

To illustrate the kind of information we feel requires this additional authority, let us give you a few examples:

1. The DOE is responsible for the physical security of numerous nuclear facilities and nuclear materials. Certain information regarding the physical protection

of these facilities cannot be classified. Examples include the physical layout of the site, general diagrams showing electrical wiring and utilities, and other information necessary to construct and operate the site, such as emergency operating procedures. We believe this kind of information should not be released to the public because it could assist in planning an attack on that facility.

2. As another example, reports are provided to us from local law enforcement agencies regarding their ability to assist us in protecting nuclear materials or facilities. This data could be useful to a terrorist or saboteur but we have no clear authority to withhold it from release.

3. Certain information concerning physical protection of small quantities of uranium and plutonium as well as other hazardous nuclear materials (e.g., Cobalt-60) is not classifiable as National Security Information but we feel it should be protected from disclosure because it could lend valuable assistance to the perpetration of acts counter to the public interest such as deliberate acts of radiological contamination.

4. There is certain Government generated information regarding nuclear weapons but which may not be appropriate for the U.S. Government to be making freely available. This information was once "restricted data" but was declassified for valid reasons at various times in the past. More recently we have seen the rise of threats, terrorism, and nuclear weapon proliferation and we are concerned that some of this unclassified material could be useful to a terrorist or an extortionist for either threatening to or fabricating an improvised nuclear explosive. In addition, such documents have been the source of design information by private individuals attempting to stimulate publication of nuclear weapons designs. We think it unwise for the government to be in a position to be required to contribute to the development of information of this nature.

5. There are certain defense related reactor designs for material production and for naval propulsion purposes which are unclassified, but which should be controlled because such designs relate closely to nuclear materials production quantities and for strategic capabilities.

To summarize, it is suggested that the public health and safety and the common defense and security are better served if the authority existed to allow the protecion of information such as these examples point out.

QUESTION SUBMITTED BY SENATOR DAN QUAYLE

Senator **QUAYLE**. Admiral Rickover, the nuclear carrier has many advantages over the conventionally powered carrier, but one of the disadvantages of a CVN is the need to replace the reactor core after approximately 15 years of use. What is the total cost (direct and indirect) and turn around time of this procedure?

Admiral **RICKOVER**. The 15 year reactor core life is actually a distinct advantage of the nuclear powered aircraft carriers over oil-fired carriers which must refuel every few days. The refueling of the nuclear carrier is planned to be performed in conjunction with a regular scheduled overhaul of the ship and is not expected to extend the length of the overhaul. Furthermore, the total estimated cost of buying, installing, removing and reprocessing the initial and one replacement set of *Nimitz* Class CVN cores, which provide for at least 30 years of ship operation, is only about $550 million in fiscal year 1981 dollars. Of this amount about $200 million is included in the initial construction cost of the ship. In comparison the estimated cost to buy, store and deliver an equivalent supply of propulsion fuel for an oil fired carrier is about $2 billion—over 3½ times the cost of providing nuclear fuel. I can provide you with the details of the fuel costs for nuclear versus oil fired warships (the information follows):

NUCLEAR VERSUS OIL-FIRED WARSHIP FUEL COST COMPARISON
(EQUIVALENT ENERGY BASIS)

For long-life reactor cores containing large amounts of fissionable material, such as cores for nuclear powered aircraft carriers (CVN's) or guided missile ships (CGN's), the operational life of the cores may be limited by the length of time the core materials will hold up in the hostile environment to which they are subjected. Based on the technical information available to date, it is expected that cores being built today will provide for 15 years of satisfactory operation. As additional data is accumulated, it is expected that it will prove feasible to assure satisfactory core life for longer periods for future cores and possibly for present cores.

A set of reactor cores for a *Nimitz* Class carrier or a new construction nuclear cruiser contains much more energy than would be expended during a 15-year period if the nuclear ships were steamed at the same low, peacetime steaming rates for which oil-fired ship fuel costs are computed by the system analysts when they make cost comparisons between nuclear and oil-fired surface warships. The result is that the two sets of cores costed for each nuclear ship over the 30-year ship life assumed in DOD cost studies could propel the nuclear ships substantially farther or at higher speeds than the amount of oil costed in these studies for comparable oil-fired ships would propel the oil-fired ships. Thus for the total fuel cost for two sets of reactor cores, the nuclear ships could be operated at a much higher tempo than that assumed by the analysts in the cost estimates for the oil-fired ships; or alternately, it may prove possible to operate the nuclear ships much longer on two sets of cores than the assumed 30 years.

One approach to account for the nuclear ship's core energy is to compare the nuclear fuel cost with the cost of the fuel that would be required to operate the comparable oil-fired ship as much as the nuclear ship could operate using two sets of cores. This comparison is made below for nuclear cruisers and *Nimitz* Class carriers.

The fuel oil equivalent in each set of new construction cruiser cores (starting with initial installation in CGN 42 and in first refueling of CGN 36 and later cruisers) is 3 million barrels and in each set of *Nimitz* Class carrier cores is 11 million barrels. Thus, the total oil equivalence in the initial and one replacement set of cores is 6 million barrels for new construction nuclear cruisers and 22 million barrels of fuel oil for *Nimitz* Class carriers. The total equivalent cost of this fuel can be estimated by using the current purchase cost, storage, and handling cost and average Navy peacetime fuel delivery cost.

However, as explained below, using current average costs for purchase and delivery of propulsion fuel oil can only approximate the relative cost of nuclear and conventional fuel; the actual relative cost is dependent on indeterminate future events.

For example, using today's purchase prices for oil and nuclear fuel results in an underestimation of the relative cost of oil, since it is expected that the cost of oil will rise much faster than the increase in general inflation affecting the cost of nuclear fuel. In this regard, it should be noted that the oil for a new oil-fired aircraft carrier or guided missile ship would be purchased in the 1987–2017 period. Oil is expected to become increasingly scarce, and its cost can be expected to rise rapidly during this period. Since most of the cost of naval nuclear fuel is independent of the cost of uranium or the cost of energy, the cost of naval nuclear fuel is not expected to increase nearly as rapidly as the cost of oil.

The average Navy peacetime fuel delivery cost has been calculated by the Navy Sea Systems Command to be $40.88 per barrel. This was computed using current ship values amortized over 30 years, current operating costs, and actual amounts of ship propulsion fuel oil delivered in a period of a year and takes into account the portion of fuel oil delivered to ships in port. If the tempo of operations of the oil-fired ships were increased, the average delivery cost per barrel would probably be different than the current peacetime average cost. If the tempo were increased by more operations close to U.S. shores in the 2nd and 3rd Fleets, the average cost of delivery would probably decrease. However, if the tempo were increased by added operations away from U.S. shores such as 6th Fleet or 7th Fleet operations or operating a 5th Fleet in the Indian Ocean, the average cost of propulsion fuel oil delivery might actually increase as existing assets become overloaded requiring additional underway replenishment forces and associated escorts, This would also result if our foreign sources of fuel oil were reduced requiring more fuel to be transported from the United States.

There are many factors affecting the tempo of operations that can be expected to change over the next 40 years, even without a war. For example, as the size of the Fleet decreases without a commensurate reduction in naval commitments, or these commitments increase, the tendency will be to require an increase in operating tempo of major combatants.

On the other hand, as the availability of propulsion fuel oil decreases, there will be a tendency to limit operations of oil-fired ships to minimize oil consumption. This will have an adverse impact on training and readiness for combat. Nuclear ships are not subject to the same constraint.

The total cost of buying, installing, removing and reprocessing the initial fuel for a new nuclear cruiser in fiscal year 1981 dollars is estimated to be $78.1 million broken down as follows:

	Millions
Procurement of initial reactor cores (SCN budget)	$44.1
Fuel installation (SCN budget)	1.2
Uranium burnup charge (OMN budget)	2.7
Defueling cost (OMN budget)	16.0
Fuel reprocessing (OMN budget)	14.1
Total	78.1

The total cost of buying, installing, removing and reprocessing each set of replacement fuel for a new nuclear cruiser in fiscal year 1981 dollars is estimated to be $88.4 million broken down as follows:

	Millions
Procurement of replacement reactor cores (OPN budget)	$44.1
Fuel installation (OMN budget)	11.5
Uranium burnup charge (OMN budget)	2.7
Fuel removal (OMN budget)	16.0
Fuel reprocessing (OMN budget)	14.1
Total	88.4

Thus, the total fuel related costs for two sets of cores in fiscal year 1981 dollars is estimated to be $166.5 million. A CG 47 Class ship would require about 6 million barrels of oil to travel the same distance as a new nuclear cruiser could travel with two sets of cores. It should be noted that to consume this much oil would require about twice as much travel over the useful life of a CG 47 Class ship than the 103,000 barrels per year assumed by the analysts for cost comparisons would provide.

The total equivalent cost of 6 million barrels of fuel oil in fiscal year 1981 dollars using the current purchase cost, storage, and handling cost and the Navsea estimate of the average delivery cost of oil delivered to Navy ships is:

	Per barrel
Storage and terminal facilities	$0.85
Fuel procurement	54.18
Average delivery cost of oil delivered to Navy ships (Navsea estimate)	40.88
Total	95.91

$95.91 per barrel times 6 million barrels equals $575.5 million.

The total cost of buying, installing, removing, and reprocessing the initial fuel for a *Nimitz* Class carrier in fiscal year 1981 dollars is estimated to be $278.3 million broken down as follows:

	Millions
Procurement of initial reactor cores (SCN budget)	$167.2
Fuel installation (SCN budget)	36.3
Uranium burnup charge (OMN budget)	10.8
Defueling cost (OMN budget)	23.1
Fuel reprocessing (OMN budget)	40.9
Total	278.3

The total cost of buying, installing, removing, and reprocessing each set of replacement fuel for a *Nimitz* Class carrier in fiscal year 1981 dollars is estimated to be $269.3 million broken down as follows:

	Millions
Procurement of replacement reactor cores (OPN budget)	$141.4
Fuel installation (OMN budget)	53.1
Uranium burnup charge (OMN budget)	10.8
Fuel removal (OMN budget)	23.1
Fuel reprocessing (OMN budget)	40.9
Total	269.9

Thus, the total fuel related costs for two sets of cores in fiscal year 1981 dollars is estimated to be $547.6 million. An oil-fired carrier would require about 22 million barrels of oil to steam the same amount as a *Nimitz* Class carrier could steam with two sets of cores. It should be noted that to consume this much oil would require the non-nuclear carrier to steam at a 47 percent higher tempo or for a 47 percent longer period than would be provided by the 500,000 barrels per year assumed by the analysts for cost comparisons.

The total equivalent cost of 22 million barrels of fuel oil in fiscal year 1981 dollars using the current cost factors cited above is: $95.91 per barrel times 22 million barrels equals $2,110 million.

Thus, using the current propulsion fuel oil purchase, storage, and handling costs and average Navy peacetime fuel delivery cost, it is estimated that the cost of buying and delivering propulsion fuel oil equivalent to two sets of reactor cores would be on the order of 3.4 to 3.8 times as much as the cost of the nuclear fuel for new nuclear cruisers or *Nimitz* Class carriers. This is much more than the propulsion fuel oil cost typically allocated to oil-fired ships by cost analysts because those costs are calculated on the basis of current average peacetime fuel usage rates applied over 30 years and do not take into consideration the much greater energy available in two sets of nuclear cores.

QUESTIONS SUBMITTED BY SENATOR HENRY M. JACKSON

Senator **JACKSON**. If the Congress directs that the Mark 12–A be retrofitted on an additional [deleted] Minuteman III missiles, the testimony before this committee [deleted].

Dr. **WADE**. As I testified, the DOD would support inclusion of additional MK12A/W–78s as an add-on in the authorization bill [deleted] and as a measure to keep this option open pending the completion of our review of a number of other force structure issues. [Deleted.] In my judgment, the MK12A/W–78 production continuation initiative does not appear to be cost effective when compared with other important systems which are currently programed for production. In any case, until our overall review of the force structure issues is completed over the next several months, it would be premature at this time [deleted].

Senator **JACKSON**. Assuming that [deleted] interruption in W–78 production is an acceptable factor in the Minuteman III retrofit program, does this change the choice of weapon [deleted].

Dr. **WADE**. For the reasons cited in the answer to the previous question, it would be premature to recommend [deleted].

Senator **JACKSON**. What is the optimal date for restart of W–78 production and what are the budgetary requirements in fiscal years 1981 and 1982 to achieve this restart?

Dr. **WADE**. The following was provided by DOE: The DOE weapons production facilities are planned [deleted] in the fiscal year 1981–1984 time frame. Because of the long leadtimes for procurement of equipment and construction materials, it takes [deleted] to provide facilities after funding is available. In order for the DOE to accommodate continued W–78 production (over and above the [deleted] warheads presently planned for) either with a minimum gap in production measured from [deleted] to the time of program direction, or with an extended gap [deleted] production capacity would have to be made available through [deleted]. As stated in responses to the previous questions, the DOD is unwilling to recommend [deleted] at this time. [Deleted.]

Senator **JACKSON**. Given [deleted].

Dr. **WADE**. The following was provided by DOE: The production required to support the currently programed stockpile requires allocation of [deleted].

Senator **WARNER**. If there is nothing further that any of you have to add, this hearing will now adjourn.

Mr. **MORGAN**. Thank you very much, Mr. Chairman.

[Whereupon, at 11:50 a.m., the hearing was adjourned, subject to the call of the Chair.]

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